THE

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THE

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WAVE PROPAGATION OF MAGNETISM.

SINCE Prof. John Trowbridge first became identified with the Jefferson Physical Laboratory at Cambridge, Mass., U.S.A., much important research has been carried on there, and many additions to our knowledge of the phenomena of electricity have especially resulted. Hitherto America has not distinguished herself to any very great extent in pure science, though her applications of the results of Old World workers need no advertisement; but now Prof. Trowbridge is only one of many on the other side of the Atlantic who are labouring to penetrate the unknown, and are succeeding in demonstrating that the "unknowable"—to borrow a term from Herbert Spencer—is becoming more and more limited.

A few weeks ago we gave a short account of a new apparatus called the phasemeter, which Prof. Trowbridge has recently designed, and which promises to be of great use in studying alternating currents. This is an ingenious application of Lissajous' method of studying the vibration of tuning forks to two telephones which take their place [*vide* ELECTRICAL REVIEW, March 18th]. The professor has recently used it in an investigation of the wave propagation of magnetism.

Attempts have been made by Dr. Harold Whiting (*vide Proc. American Academy of Arts and Sciences*, 1881, p. 14) and by F. T. Trouton (*vide Nature*, 1891, November) and others, to discover a wave propagation of magnetism along bars of iron or around rings of this metal; and the usual plan has been to subject the iron to alternating currents of a certain frequency, and to search for nodes along the bars or around the rings by employing small secondary coils of wire connected with a ballistic galvanometer or with telephones. The success of these investigations has been rather indifferent, and has left much to be desired.

Prof. Trowbridge has been examining this question of wave motion by means of the phasemeter, which he finds well adapted to such research. He employed it both on rings and on straight bars of iron, laminated and solid. The ring with which most of the experiments were performed was three feet in diameter, and the diameter of the cross-section was half an inch. Two large coils of coarse iron were slipped through the ring, through which an alternating current could be passed. These coils could be separated or joined together, and by a commutator opposite poles or poles of the same name could be opposed. Two small coils of fine wire were also slipped upon the ring; each of these coils was connected with a telephone. The diaphragm of one telephone gave a horizontal line of light, and that of the other a vertical line, the combination of the two amplitudes giving a straight line, an ellipse, or a circle. The projection of these figures on a screen makes a very interesting lecture experiment.

The distribution of magnetism between the coils when the

same poles or opposite poles were opposed to each other, was examined on placing one of the small coils at a fixed point on the ring on one side of one of the large coils, and the other small coil between the two large coils. A preliminary experiment in which the two small fine coils were on the same side of one of the large coils gave no indication of nodes, or change of phase. Where, however, one coil was placed in the manner described between the two coils, and one on the opposite side of either of the coils, the following phenomena, which are sufficiently obvious, were observed. With a current of 250 alternations per minute, an ellipse was seen in the phasemeter, when the coils were at an equal distance from the ends of either of the large coils. When poles of the same name were opposed to each other, the ellipse changed from an ellipse with its major axis inclined to the right, to an ellipse with this axis inclined to the left or the reverse, thus indicating a difference of phase of 180°.

At the central point on the iron between the two poles of same name, the small coil placed there indicated no lines of force threaded through it, and consequently the telephone connected with this coil gave no amplitude, and a line of light either horizontal or vertical was given by the other telephone. When poles produced by the current in the large coils were of opposite sign, there was no appreciable change of phase produced by moving one of the small coils on the iron between these poles; only the amplitude of the diaphragm of the telephone connected with it changed.

The reason of the change of phase in the first case is obvious. In the case of two poles of the same sign which are opposed, the lines of force are threaded through the coil in one direction on one side of the middle point of the iron between the coils, and in the opposite direction on the other side of this middle point. With poles of opposite sign opposed, the lines of force are threaded in the same direction in whichever way the small coil is moved between these poles. The same phenomena can be observed on straight bars.

An interesting manner of showing the change of phase produced by the opposition of poles of the same or contrary sign, is to place one of the small coils on the core of a large coil at one end of this latter coil, and to place the other small coil on a small rod of iron or steel, and to bring this rod with its coil near one end of the core of the large coil, and afterwards to the other end. The change of phase of the ellipses is readily shown, and is evidently due to the threading of the lines of force by induction through the small coils in the same or in opposite directions.

If an incandescent lamp of about 1 candle-power is connected with one of the small coils, and the coil is placed on the iron ring between poles of the same name, the lamp will not glow; but on changing the poles so that two of opposite sign shall be opposed, the lamp immediately glows. This point, however, cannot be called a true nodal point, and Prof. Trowbridge, in his paper contributed to the current number of the *Philosophical Magazine*, states that he has failed to find any other. Although it is probably true that the most distant molecule of the iron quivered under the periodic alternations of magnetism to which it was subjected, yet there was no wave motion along the iron ring. Just as a distant molecule might have responded quickly to the first application of heat to the ring, there is no true wave motion in the propagation of the heat.

Prof. Trowbridge thinks that the propagation of magnetic disturbances produced by forced oscillations on iron bars is closely analogous to the propagation of heat over these bars, and that each molecule of the iron swings under the directive moment of the magnetic field something like a pendulum in molasses.

Instead of the formula:

$$\frac{d^2 u}{d t^2} + k\frac{d u}{d t} + n^2 u = \text{E} \cos p t,$$

we have:

$$\frac{d^2 u}{d t^2} + k\frac{d u}{d t} + n^2 u = 0.$$

The curve of distribution of magnetism on the ring can be made to agree closely with an experimental form, which is evidently the solution of the second of the above equations.

To ascertain whether changes of phase could be detected between the inner portion of a thick iron core, subjected to alternating magnetic impulses, and the outside of this core, Prof. Trowbridge placed one of the coils of the phasemeter in a channel which was turned about the centre of a core of iron, the diameter of the curve being 2¼ inches. Another coil, with its centre coinciding with the centre of the imbedded coil, was slipped on the outside of the core: no changes of phase could be observed between the inner and the outer portion of the iron core.

When an armature was placed over the imbedded coil, thus completely closing it in iron, hardly any lines of force were threaded through it. They were diverted to the surface of the iron core. Here was a case of Thomson's marine galvanometer, and the amplitude shown by the telephone diaphragm connected with the imbedded coil was reduced to almost nothing. When, however, the armature which extended over the entire cross-section of the core was removed, and an armature was employed which extended the iron which passed through the centre of the imbedded coil beyond the limits of the ends of the thick core, the lines of magnetic force were brought down from the surface of the iron, and made to thread themselves through the imbedded coil.

Properly chosen armatures can be made to closely resemble arrangements of lenses, bringing magnetic lines into bundles, or spreading them. An incandescent lamp can thus be made to glow when it is connected with a coil imbedded in iron, by diverting the lines of magnetic induction through it with suitable armatures.

The phasemeter can be employed with advantage to illustrate the distribution of the lines of force about an electromagnet. By reducing the diameter of the iron ring on which the coils are slipped, so that a sufficient number of lines of force are threaded from the north pole to the south pole of one of the large coils, it can be demonstrated that an incandescent lamp can be lighted even when it is outside the coil in a plane perpendicular to the axis of one of the large coils, and passing through its centre. It is evident that there would be no induction through the coil if the iron did not make a magnetic circuit.

The experiments thus carried out by Prof. Trowbridge were performed with an alternating machine, giving currents of the period of 2,500 to 5,000 a minute. Doubling the rate of alternation only produced changes in amplitude.

Dr. Harold Whiting could find no true nodes in the propagation of magnetism along bars, and the phasemeter shows none. Prof. Trowbridge concludes that the propagation of magnetic induction in iron and steel is expressed by

the equation of motion of molecular magnets in a resisting medium rather than by the equation of a wave motion.

As we said at first, the phasemeter promises to be exceedingly useful in studying the subject of alternating currents. By means of it the effect of different qualities of iron and steel in increasing the self-induction of, and therefore the impedance of, branch circuits, can be readily examined; it can be made of great use in steadying alternating current motors. It is well known that two or three electrodynamometers must be employed in the ordinary methods of determining change of phase. The phasemeter can be quickly employed, and its adjustments are extremely simple. Lord Rayleigh and others have demonstrated that differences of phase between branch circuits exist, and we understand that Prof. Trowbridge is engaged upon this study, and that a paper full of results may shortly be expected.

The Durability of Pure Aluminium.

Quite a feature of the aluminium boom has been the number of contradictory statements published concerning its durability, whilst almost every observer has something different to record concerning its corrosion by acids. The fact is extremely likely that the metal examined has not always been pure. Most of the experiments have been of the "laboratory" type; it is interesting, therefore, to notice some of a more practical kind. In 1877, C. Winkler published in the *Deutsche Industriezeitung* results showing that with continuous use the losses of weight in three spoons of different composition were as follows:—

	Per cent. per year.
Silver spoon	0·403
Aluminium spoon	0·630
German silver spoon	1·006

These spoons have now been in use for 16 years, during which, however, the German silver spoon has not been used with the same regularity, and Winkler has again estimated the wear and tear. The loss during the 16 years has amounted to the following:—

	Per cent.
Silver spoon	8·78
Aluminium spoon	5·85
German silver spoon	5·62

The loss on the former is probably too high, owing to continual polishing, that on the aluminium spoon may be taken as correct, since it was merely cleaned with a soapy flannel, as a rule attempts at polishing being useless. The loss on the German silver spoon is decidedly too low, because it has not been so regularly used. It thus seems evident that as regards durability there is not much to choose between silver and pure aluminium, whilst the alloy wears away more easily than either. This result contradicts some recent statements by Lübbert and Roscher.

Electricity *v.* Electrics.

Our contemporary, *Electricity*, seems mildly annoyed with the criticisms which we passed a short time ago upon the American coinage of words, and especially with our remarks upon the proposal to bring in the word "electrics" to denote the science of electricity. We agree that "nowhere is system so necessary as in science and in the terms therein employed," but if "uniformity in terminology" be consistently used and introduced throughout the whole range of science as *Electricity* appears to desire, nothing but a hopeless muddle can ensue. For the science of electricity is *not* analogous to that of mineralogy, chemistry, zoology, entomology, &c., and hence the introduction of such nomenclature as is used in these departments of knowledge must be accompanied with anomalies. When we wrote the paragraph of which *Electricity* complains, we were thinking perhaps more of the general liberties which our over-the-water cousins take with their mother tongue, than of this new suggestion. Our English writers, especially amongst the "new journalists," are unfortunately not always purists, but Americans often appear to pride themselves upon the eccentricities of diction which they indulge in. "It is a mighty poor sort of Yank that can't draw on his think-tank for a word when he does not find it in the lexicographical market," was the retort of the American correspondent of a contemporary when his literary style was called in question the other day.

Cost of Electric Light at Blackburn.

A circular letter has just been issued by Mr. W. Gaine, the Town Clerk of Blackburn, for the purpose of ascertaining the probable number of consumers of the electric light. The cost, it is stated, will be 7d. per unit, "which is equal to that of gas at 5s. 10d. per 1,000 cubic feet." We would point out that Mr. Gaine has, like many other gentlemen, fallen into a common error in making this statement. In our leading article on February 5th, and in a subsequent number, where we vindicated the position we had adopted in referring to this question, we went very minutely into the matter; and it is, therefore, quite unnecessary for us to repeat our assertions. It will be found on working out the figures that instead of 7d. per Board of Trade unit being equal to gas at 5s. 10d., it is equivalent to gas at 7s. per thousand cubic feet. It is to be regretted that town clerks and others fall into error concerning the real cost, and so mislead possible consumers.

Has Electricity Momentum?

Prof. Dolbear, before the American I.E.E., described lately an experiment which he has made on the important question of whether electricity possesses momentum or not. Several experiments have been made by various observers to test whether a current possesses momentum in the direction of its flow, and the result has always been negative. Prof. Dolbear's experiment deals with angular momentum; he suspends a small hollow cylinder of very light material, and passes a current down it; on the making of the circuit he has noticed a sudden twist of the hollow cylinder, and this may be made quite a considerable amount by timing the impulses. Prof. Dolbear considers that his experiment is fairly conclusive, but may be open to doubt: it is, of course, quite possible that some slight want of symmetry in the leading in wires would cause these motions by means of the horizontal field of the earth; this is the more likely as fairly large currents have to be employed to make the effect visible.

Does Lead Absorb Hydrogen in a Secondary Battery?

In order to explain certain physical phenomena which take place at the negative plate of a secondary battery, G. Neumann and F. Streintz assumed in a paper published in the *Monatshefte* a short time ago, that lead has the power of absorbing hydrogen. Such an assumption could not be allowed to stand without receiving experimental confirmation, however convenient for bridging a difficulty it might be: so they have put it to the test under conditions which were arranged so as to be comparable to those existing in the secondary battery which they were investigating. No trustworthy conclusions could be deduced from the results obtained; and this illustrates the unwisdom of making any assumptions which are difficult to substantiate. When the metal was exposed to the action of hydrogen while it was in a molten condition, they found it was capable of absorbing from 0·11 to 0·15 of its volume of the gas; but this result has but an indirect bearing on the case in question, which cannot be said to have been properly answered.

Currents in Quadrature.

It is somewhat late in the day to suggest getting currents in quadrature by means of the primary and secondary currents in a transformer, as is done by a correspondent of the *Electrical World*. The fact that an underloaded transformer has its currents not far from 90° apart is fairly well-known to most electrical engineers who are acquainted with the effects of alternating currents; unfortunately in order to get a fair approximation to quadrature the transformer must be greatly underloaded. This means that a very large piece of apparatus would be required to work even a small motor, and consequently the practical utilisation of the idea is not very promising. The fact that a Tesla motor operates when supplied in the manner indicated is not a sufficient test of the currents being truly in quadrature, as rotations would occur even with very fairly large deviations from the theoretically perfect phase-difference. The result would, however, be a very low weight efficiency in addition to a low energy efficiency. Probably the best way to get a suitable phase difference is by means of combinations containing a condenser, although the present method will doubtless be of considerable service for small powers and laboratory work.

Which Terminal shall we Ground in Electric Railway Circuits?

Mr. C. P. Steinmetz, in an article in the *Western Electrician* of Chicago, points out that this question is not so unimportant as might at first sight be imagined. The earth is not a "metallic" conductor, that is, a conductor which carries the current without change of its chemical or physical constitution but is an electrolytic conductor wherein by the action of the current, chemical changes are produced. The result has been rapid destruction of return wires and rail bonds. It has been customary to connect the negative terminal with the return circuit and the positive terminal with the trolley line; but, as Mr. Steinmetz points out, by an analysis of the position of affairs, it is really immaterial which arrangement is adopted; in one case it means that one-half of the return circuit is the more attacked and in the other case the other half suffers. As regard the local currents between the rail and return wire, it is, if anything, more advisable to connect the positive terminal to the return circuit, which practice is of some advantage, too, if a separate ground in the central station is provided.

Bare Underground Conductors.

It is pointed out in *L' Electricien* that not only does serious deterioration go on when the bare wires are in the presence of moisture, owing to the formation of hydrocarbonate of copper, a formation which is accelerated when the wires become reduced in section and consequently heat to a greater extent, but it has apparently been proved that an explosion which took place in Paris was due to the generation of gas from the electric decomposition of moisture, which gas was fired by the presence of sodium, also due to a decomposition taking place, and not to any electric spark. Thorough ventilation would seem to be the best remedy against such accidents.

Standards of Light.

In a leading article in our issue of January 15th, we referred to the controversy between the London County Council and the Board of Trade regarding the appointment of a committee to consider a more scientific standard of light for gas testing purposes. During the past week the London County Council summoned the Gas Light and Coke Company for having supplied gas of less illuminating power than was required under the Gas Light and Coke Companies Act, 1876, at the testing station, 116, Lambeth Road. In opening the case, it was stated that the result of tests made at the station showed the illuminating power of the gas to be deficient by $\frac{8}{10}$ths of a candle. On the other hand, however, the gas company on making similar tests at their station found the average illuminating power to be on one occasion ·24 *above*, and at another date ·9 *above* the stated standard of 16 candles. The tests of the council were made almost immediately before those of the gas company on the same dates. When the case came on, however, the magistrate fined the company 40s. and 23s. costs on each summons. It is very evident that there must be some mistake in the tests made by one of the parties, and we should think that the error lies with the County Council, considering that the gas company should be far better able to make accurate tests than the former body. The gas company is more matured in its experience of testing than the Council, and taking this into consideration, we think the magistrate would only have been acting reasonably had he dismissed the summons, instead of taking the evidence of one man against another, where there was no tangible evidence to show that either was correct. But then, perhaps, it would be too much to expect that our magisterial dispensers of the law should be versed in photometry, or rather in its defects.

The Resistance and Self-Induction of Branch Circuits.

Many students of the mathematical side of the science of electricity will feel indebted to Prof. A. Anderson for a simplified method of obtaining the values of the effective resistance and inductance of a system of conductors connected in parallel and acted upon by an impressed electromotive force varying according to a simple harmonic law; the conductors themselves being supposed to have no mutual induction. This method of obtaining the results does not differ much from that given by Lord Rayleigh in a paper published in the *Philosophical Magazine* of May, 1886, but Prof. Anderson has succeeded in making it somewhat simpler to understand, and has also applied it to finding the effective resistance and inductance in the case where the conductors *have* mutual induction. The results referred to have also been quoted on p. 134 of Fleming's "Alternate current transformer," Vol. i., and the new method of obtaining them is to be found in the *Phil. Mag.* for April, p. 352.

New Conductivity Phenomena.

The electrical conductivity of a gas heated between two platinum plates, the latter being at a red heat, has been demonstrated by Edm. Becquerel and confirmed by Blondlot. Some new observations on the conductivity of heated gases have been lately added to our knowledge by Branly, who contributed a paper upon the subject at a meeting of the Paris Academy of Science, held April 4th. The paper was illustrated by experiments which were designed to show that when gases are contained between metal surfaces, the metal on the one hand being maintained at the ordinary temperature and on the other at a red heat, they still retain their conductivity. It was observed that when the colder metal is electro-negative the conductivity of the gases is largely increased.

Thunderstorms.

The report on the thunderstorms of 1888 and 1889 which has been recently issued by Mr. W. Marriott on behalf of the Royal Meteorological Society is not very instructive reading, for although some interesting facts are stated, it appears to have been impossible to arrive at any rules of a definite nature, as the results of the observations made. Here and there we come across an attempt to lay down a law, such for instance as the statement: "It appears that lightning strokes occur most frequently when there are numerous oscillations in the barometric trace." We also find it stated that "thunderstorms accompanying large barometric depressions usually occur in the south-east quadrant, and at some distance from the actual centre of the depression." The rate of progression of a storm is often 50 miles an hour, and a series has been traced in a direct line from north to south, a distance of 400 miles. Mr. Marriott thinks that the average altitude of a thunderstorm does not extend beyond about 5,000 feet above the earth's surface.

ARC LIGHT WIRING.*

By S. H. SHARPSTEEN.

Mr. W. B. Rommel's comments† on my article‡ on arc light wiring may mislead parties who are not very well versed in the electric lighting business. Persons conversant with the business will see at once the point at issue, and if they have not thought over the system previous to seeing my article, will understand that it is good under the circumstances which I mentioned.

In the average town the commercial lamps are very nearly all on one street and short streets off from it. The municipal lamps are, as a rule, two blocks apart. Mr. Rommel seems to think that the main street cannot be without the city wire for a time to make a loop and come back two or three blocks below or above. He speaks of putting one side of the street circuit on one street and the other side on another, or down one street and up another. Such a town would have to be made up of two long streets with short ones intersecting, and in this long and narrow town the three-wire system of arc wiring is at its best as it is cheaper to loop down to the lamps on the second street at every block than it is to build another pole line. If the town is deeper than three streets the looping has got to be done anyhow.

Mr. Rommel speaks of the arc lamps that he has installed running the full current through the magnet coils after the lamp is cut out, and this current passing through the magnet coils interfering with the adjustment of the lamp, &c. Will Mr. Rommel please give us the name of the arc lamp that he speaks of?

Mr. C. G. Young in his article§ puts the matter in the proper light to lead a person into the pros and cons. When I wrote the article I had in mind small stations of from 50 to 80 arc lamps. Stations from which a large number of street lamps are worked have no particular use for this system on their street light circuits at any rate. To get the economy down directly to dollars and cents, as Mr. Young speaks of, was not the point I had in view either.

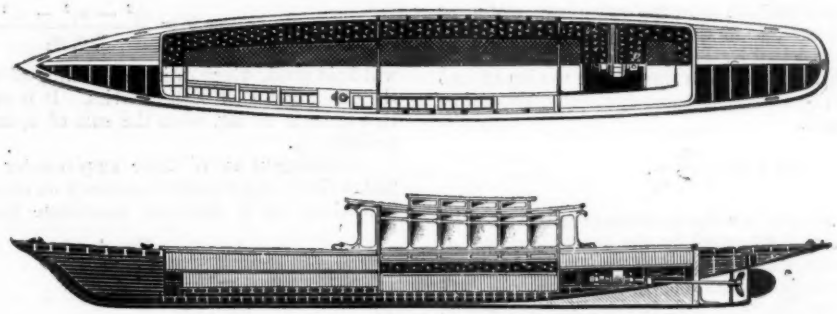
In the installation of a plant for public lighting one of the very prominent questions that suggest itself is, "How can we avoid having the commercial lamps out?" To get good prices, good service must be rendered. A commercial arc circuit that is out oftener than once a year is not a success; once in five years I consider bad if it be out for any length of time. It is understood here that what is meant by being out is not to have the light when it is customary.

Another question is, can a street circuit for street lighting be as proof against being "open" as a commercial, or, better, an inside, commercial circuit? This question, I think, is very easily answered in the negative. An inside commercial circuit put up by the right man will never get "open" we may say, but of the outside circuit, suspended in various ways, full of loops running to lamps in centre of streets and to all kinds of fixtures, the wires are liable to get broken or worked loose. A plant could not be installed for me and have the inside commercial lamps on circuits with street lamps, as street lamps are now installed. Again, when the street lamps are in circuit with the commercials, if they be of equal number and equally proof against open circuits, the commercials have double the chance of being out from open circuit. There are a great many towns where they have from 50 to 80 arc lamps very nearly equally divided between municipal and commercial or inside and outside lamps. For good service at times during the year the inside lamps have to be started as early as 3.30 and 4 p.m.; 5.30 would be early enough for the street lights at the time mentioned above. Some towns use their street lights until 12 and 1 a.m. only. Twenty-five or forty arc lamps worked for 1½ hour is quite an item, and with the people that have no street lights after 1 a.m., the run from 3.30 p.m. until 1 a.m. is too long for single lamps with $\frac{7}{16}$th carbons, which it is economy to use.

From 10 years' experience in connection with both large and small stations, I conclude that if there are to be worked 50 or up to 80 arc lamps about equally divided between outside and inside lamps, I should want the inside lamps on a separate circuit. If there are to be two circuits it is evident that it is cheaper to put commercials on one side, street lights on the other and at the last commercial or the last street lamp connect on a third wire and run the same to the station.

It may seem a little obscure to some what I mean by the outside and inside lamps being on separate circuits when in fact they are both on one circuit. The point is here: With the three wires at one's service, if the arc circuit goes out from outside trouble, the person in attendance can close the inside lamp loop through the third wire, and if the trouble is on the other leg, his commercials will come up at once.

* New York *Electrical Engineer*.
† The Electrical Review, April 15th.
‡ The Electrical Review, April 8th.
§ The Electrical Review April 15th.



Sectional Plan and Elevation of Electric Launch.

ELECTRIC LAUNCHES.

There will be a great increase of electric launches on the river Thames this year. The makers of electrically propelled boats are busy, and we shall be soon able to draw comparisons between steam and electricity on river craft. With the electric boats comes a new feature on the banks of "Father Thames." Charging stations must be provided to meet the wants of the electric fleet.

The most recently designed charging station is to be situated above Richmond Bridge at Eel Pie Island, owned by Mr. Sargeant, who was one of the first to design and construct the floating charging stations now generally used.

The charging station will contain a 100-H.P. engine, which will transmit power to two shunt-wound dynamos, for charging the launch accumulators. Resistances are so arranged that any electromotive force between 100 and 300 volts with a current of 200 ampères can be attained; this can be divided into twelve circuits. These dynamos will also transmit the current to the motors in the workshops, which will be used to drive the lathes, &c.

Andrew Pears, Esq. (of soap fame), has given Mr. Sargeant another order. The new vessel is to be at the next Henley Regatta. She is designed especially for speed, and, in appearance, will somewhat resemble a torpedo boat. This is the fourth order Mr. Sargeant has received from that gentleman.

Amongst other electric launches in the course of being laid down are two for the "Star and Garter" Hotel, Richmond Hill, for the use of pleasure parties during the summer months, and an electric launch 75 feet long with 13 feet beam. There will be every convenience on this vessel; the saloon will be illuminated with incandescent lamps of 100

volts; port, starboard and masthead lights will also be electric. The steering wheel will be placed on the saloon deck amidships, so that the steersman has full view of the river. Alongside the wheel will be the switch controlling the electrical power, which will consist of one single lever (patented by Mr. Sargeant), and is arranged for "full-speed ahead," "half-speed ahead," "full speed astern," "half-speed astern." The electrical power will be stored in the same way as in the *Viscountess Bury;* the accumulators are to be of the latest type, in ebonite boxes, and will be supplied by the Electrical Power Storage Company, Limited. The potential of this vessel will be 400 volts, transmitting the power to the motor driving the propellor connected up direct with the armature shaft and rotating at 600 revolutions per minute. The lines of this vessel are calculated to give a speed through the water of 8 knots, the displacement being 16½ tons. She will be running during the summer months from the new lock at Richmond to Teddington.

The business carried on at this station will be under the name of the "Thames Electric and Steam Launch Company," with Mr. W. S. Sargeant as manager.

The illustrations show the general arrangement of the launches.

MEASUREMENT OF THE LAG BETWEEN TWO ALTERNATING CURRENTS.

IN the increasing application of alternating currents for power, it is of great importance to know the exact angle of lag between different circuits, as in the multiphase motor, or to ascertain its absence, as in the Stanley motor. A direct measurement of the actual lag is without doubt preferable to calculating it. Mr. Blakesley has shown that the lag of two currents, measured by the use of three dynamometers, can be found by the formula

$$\cos\theta = \frac{a_3}{\sqrt{a_1\,a_2}},$$

where a_1 is the reading when the instrument is traversed by one current alone, a_2 if traversed by the other alone, and a_3 the reading when one current is going through the fixed coil and the second through the movable coil.

This method, says Mr. Otto Holz in the *Electrical World*, has the disadvantage of requiring three dynamometers, as the instruments must be left in the circuit during the test on account of their self-induction.

Profs. Ayrton and Sumpner have measured the lag between the current and P.D. of one circuit by the use of only one voltmeter, taking three readings:

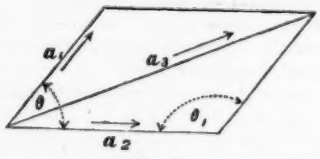


FIG. 1.

If a_1 is the P.D. of the inductive and a_2 that of a non-inductive circuit, they can be compounded after the well-known parallelogram of forces, fig. 1.

If both P.Ds. are put in series, their sum is represented in magnitude and direction by the diagonal a_3. By trigonometry we get

$$\cos\theta_1 = \frac{a_1^2 + a_2^2 - a_3^2}{2\,a_1\,a_2}.$$

But θ, being the supplement of θ *s*, has its cosine equal in magnitude, but opposite in sign to $\cos\theta_1$:

$$\cos\theta = \frac{a_1^2 - a_1^2 - a_2^2}{2\,a_1\,a_2}$$

The writer proposes to extend this method to the measurement of the lag of two or more currents, which are independent of each other, each having its own circuit, as is the case with motors, in the following manner:

Two non-inductive resistances are put in series with the magnetising circuits, as shown by fig. 3*. Their P.Ds. are measured first separately, then after connecting two ends by a wire, *l*, and the other two through the voltmeter, the third

FIG. 2.

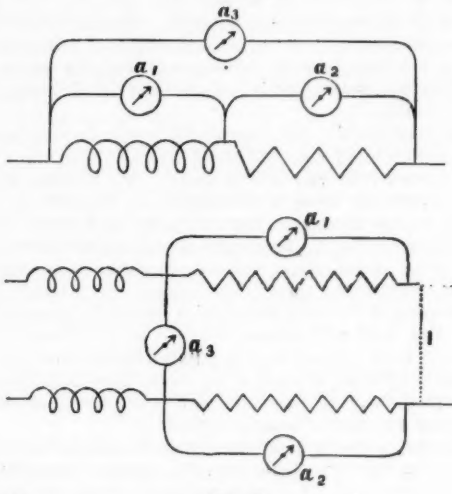


FIG. 3.

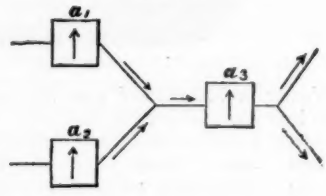
reading is taken, which shows the P.Ds. of both non-inductive circuits in series. Therefore the same formula—

$$\cos\theta = \frac{a_3^2 - a_1^2 - a_2^2}{2\,a_1\,a_2}$$

will hold good, where a_1 is the reading of one circuit, a_2 of the other, and a_3 of both in series. It is evident from fig. 1 that there is no lag, when the sum of a_1 and a_2 equals algebraically a_3.

An analogous use of three ampèremeter readings (fig. 4), makes three ampèremeters necessary on account of their self-induction, but it does not necessitate the raising of the

FIG. 4.



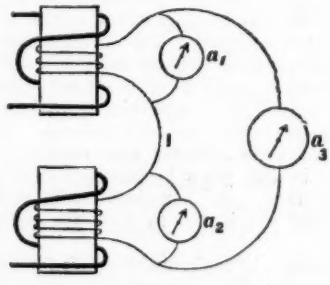


FIG. 5.

E.M.F. of the generator, lest the current be diminished by the additional non-inductive resistance.

We have yet to consider that the magnetisation lags behind the magnetomotive force (fig. 5), and if the magnetic circuits, around which the currents are flowing, differ, the lag between the magnetisations is not represented by the lag between the currents. It is therefore preferable to place fine wire coil in inductive relation to the magnetic circuits, for as the P.D. of each fine wire coil lags exactly 90 degrees behind the magnetisation, their angle of lag is not altered and represents the lag between the actual magnetisations.

* Fig. 2 is not mentioned in the original.—EDS. ELEC. REV.

The fine wire coil is closed only through the high resistance of the voltmeter and does not allow enough current to flow as will introduce a perceptible error by diminishing the counter E.M.F. of self-induction of the magnetic circuit. In this case the E.M.F. of the generator need not be raised.

THE BRILLIÉ ELECTRICAL ENERGY METER.

THE principal features of this apparatus are as follows :—The quantity of electricity is measured by an electro-dynamometer, to the movable bobbin of which a copper ring is attached, and placed midway between two sets of permanent magnets, whose opposing poles, facing one another, create in the ring a magnetic field.

These magnets are fixed on an axle, which is rotated by means of a small electromotor.

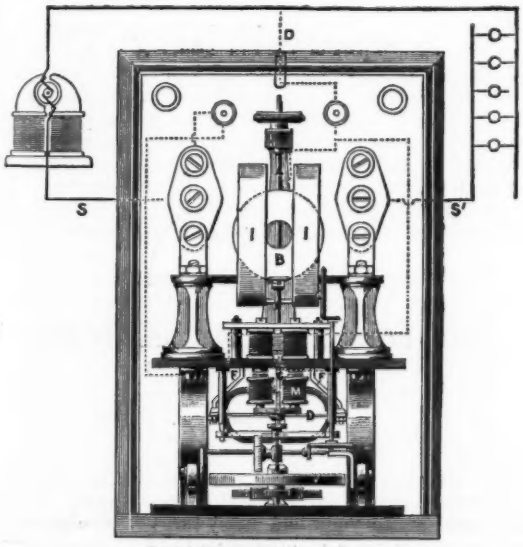
When the current is passing, the electro-dynamometer coil is deflected to a small angle, carrying with it the copper ring, the permanent magnets on the other hand are rotated in the opposite direction, and produce in the disc a motion tending to bring it back to its original position.

The force thus exerted is proportional to the speed of the magnets, which speed is controlled by means of resistances placed in series with the motor, which are inserted or withdrawn by the electro-dynamometer itself.

If the rate of speed is not sufficient, it is increased by the action of the electro-dynamometer coil, in not returning to zero; and on the contrary, if it is too great, the bobbin is deflected over zero, and the current broken.

Equilibrium is attained when the force exerted by the magnets is equal to that of the electro-dynamometer; in actual working, this effect is constantly maintained, and, consequently, the rate of speed is proportional to the strength of the current, *i.e.*, to the quantity to be measured. It only remains to register this on a counter to get the required valuation.

The details of the instrument are as follows :—Fig. 1 gives a front and fig. 2 a side view of the apparatus.



D, Derivation; S, Station; S', Consumer.

FIG. 1.

The electro-dynamometer consists of a pair of fixed coils, I and I, of copper ribbon, which take the whole current, and are in series with the lamps, and a suspended bobbin, B, of fine wire, connected in shunt with the main circuit, which measures the difference of potential.

A copper disc, D, is connected by three arms to the bobbin, B, and the whole suspended by a fine metal wire, passing through the axle, the great length of this suspension enabling the torsion error to be neglected, as the coil, B, is never deflected through a great angle.

The permanent magnets are arranged in the form of two cones, and their successive poles are alternately N. and S., as shown in fig. 3. The motor which actuates these magnets is shown at M (figs. 1 and 2), and is constructed of five coils, two stationary, forming the inductor, and three revolving, forming a sort of armature of three sections, and provided with a commutator of three segments.

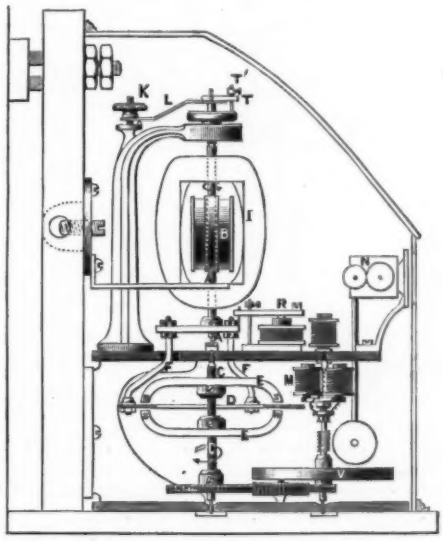


FIG. 2.

These five coils are connected up in series. The speed of the motor is regulated by a fly-wheel, V, and motion is imparted to the magnets by a train of wheels, and the revolutions are registered by an endless screw, acting on a counter, N, which shows by a series of dials the number of watts supplied.

It was mentioned that the electro-dynamometer regulated the speed of the motor: it does so by altering the resistance in the circuit by means of a rheostat, and the necessity

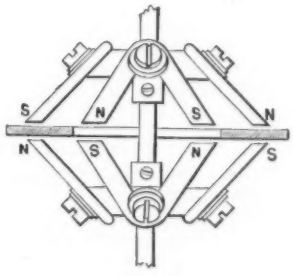


FIG. 3.

of having an extremely small, and yet perfectly simple rheostat proved a serious difficulty, but in fig. 4 is shown the ingenious manner by which this difficulty was overcome.

The rheostat consists of two resistance coils wound on one bobbin, shown in R, fig. 2, and its action is explained in fig. 4 (R and R_1).

The regulator consists of an insulating piece, S, movable round an axis, *s*.

On either of side S are fixed flexible brushes, b_1 and b_2, the former connected permanently by the axis, *s*, with one part of the main circuit, and the latter with a contact, t'.

Four contact pins, numbered 1, 2, 3, and 4, are fixed on an insulating disc carrying the pivot, *s*, in such manner that by oscillating S, the brushes, b_1 and b_2, come alternately in contact with the pins 1 and 3, 2 and 3 or 3 and 4.

The displacement of S is made by the arm, *t*, forming a contact fixed on the axle, A, of the electro-dynamometer coil, and consequently moving with it.

When no current is passing through the meter (fig, 4), the arm, t, rests against the insulating piece S in t'', the brush, b_1, presses against the contact pin 1, without touching 2; and the brush, b_2, is in contact with 3 and insulated from 4.

The contact pin 1 is insulated entirely; 2 and 3 are in connection with the resistances, R and R_1, placed between

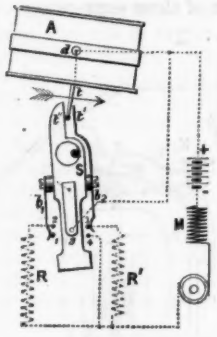


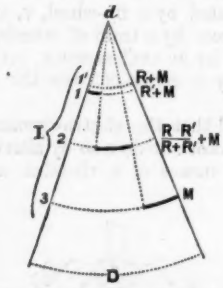
FIG. 4.

the motor and these contacts, and 4 is connected direct to the motor, M. When in this position no current can pass through the motor.

The coil, B, is the only one which is always traversed by the current when the general circuit is loaded.

When the smallest current traverses the large coils, the bobbin, A, of the electro-dynamometer, through which the current is constantly passing, is deflected, carrying with it the arm, t, in the direction of the arrow.

The contact of t, t', is established and the motor circuit completed by + A, t, t', b_2, 3, R^1, M −, giving the current the value represented by 1 (fig. 5).



I, Intensities; D Angular displacement of the coil A.

FIG. 5.

The arm, t, still being drawn to the right by the preponderant action of the electro-dynamometer, over the influence of the permanent magnets carries with it S, and the brush, b_1, comes into contact with pin 2.

The resistance, R, is then brought into play as a shunt to R_1, and the motor circuit now becomes

$$+ \left\{ \begin{matrix} a\ t\ t'\ b_2\ 3\ R^1 \\ s\ b^1\ 2\ R \end{matrix} \right\} M -$$

and as the resistance decreases, the current increases to the value represented by 2 (fig. 5).

If now S is still moved to the right by the arm, t, then the brush, b_2, comes into contact with pin 4 and the circuit becomes

$$+ a\ t\ t'\ b_2\ 4\ M -$$

representing the value 3 (fig. 5).

In this position the action of the magnets will more than counterbalance the effect of the electro-dynamometer, and the contact arm, t, will move in the opposite direction, thereby breaking contact with t'.

The circuit then becomes

$$+ s\ b_1\ 2\ R\ M -$$ represented as 1′. (Fig. 5.)

If the contact arm, t, still continues to move in the opposite direction to that indicated by the arrow, it carries with it S, and the brush, b_1, leaves pin 2 and passes to 1, thus breaking the circuit.

It will thus be seen that :—

(1) The current in the motor is greater when the electro-dynamometer coil moves to the right.

(2) It suddenly diminishes when the coil is moved to the left.

(3) The breaking of the circuit takes place at t, t', or b_1 2, through the resistance R or R^1, that is, when the current is at its minimum.

In actual working, the bobbin, B, by slight oscillations constantly alters the value of the motor current, so that the mean strength gives precisely the speed required to maintain the coil in equilibrium, and these small impulses, which are constantly received by the motor, make it unnecessary to adjust the exact resistance to attain this effect.

As these impulses are alternately in different directions, and as by its inertia, the motor cannot obey these impulses instantaneously, it follows that the speed represents exactly the value of the current and gives a measure of it.

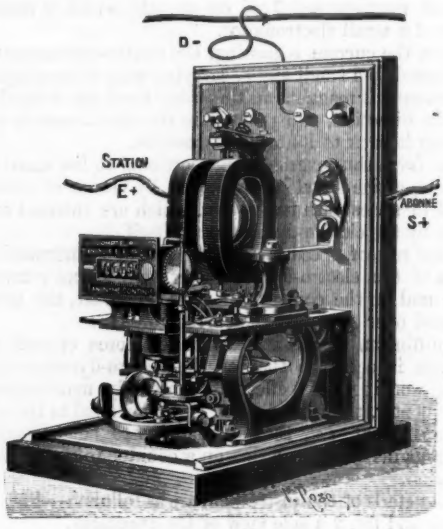


FIG 6.

This apparatus is very sensitive, being constructed to measure a $\frac{1}{1000}$th part of the full load. A 10 ampèremeter will start with a current of ·05 ampère. The consumption of current by the meter is very trifling, being about a $\frac{1}{1000}$th part of the total registered. The meter will will work with the same precision on alternate current circuits by simply changing the electro-motor bobbins.

Fig. 6 gives a general view of the instrument. This meter appears to possess great advantages and is stated to be very accurate, and excellent results may be obtained from it.

THE CONSTANTS OF TELEGRAPH APPARATUS.

BY W. MOON.

THERE are many points relating to telegraph apparatus that are not dealt with in ordinary text books. It is, for instance, often necessary to know how many turns of wire are wound upon a certain piece of apparatus, the pull which certain electro-magnets exert, and the intensity to which the coils of the different pieces of apparatus are magnetised. In the following article I give some of these constants together with descriptions of the methods by which they may be measured.

THE RELAY.

In all electro-magnets the flux of induction or the total number of lines of induction is greatest through the middle of the iron core upon which the coils are wound, and least in the middle of the armature or in the air space between the poles. It is important that both the flux of induction and

the induction should be known for all parts of the so-called magnetic circuit.

In any coil the product of the inductance and the current is equal to the summation of the flux of induction through each turn of the wire, so that

$$\frac{L\,I}{n}\,10^8 = \phi_{mean}$$

where L is in henrys and I in milliampères.

For instance, the B standard relay with its coils in series has about 8,400 turns of wire and an inductance of about three henrys, so that with 20 milliampères of current ϕ mean = 715 lines. This is the mean flux of induction for all the turns of the coil. The flux of induction for any one part of the coil may be measured by winding n turns of wire round that part, and taking the discharge, q, produced through a resistance, R, when any current is sent through the coils

$$\phi = \frac{q\,R\,100}{n}$$

where q is in micro-coulombs, R in ohms, and ϕ in C.G.S. units.

A value of ϕ measured in the middle of one of the coils of a B relay with 20 milliampères current gave 905 lines, while the number of lines through the tongue was found to be but 300 or only a third of that through the centre of the coil.

The sectional area of the core of a B relay is about ·7 square centimetre so that the mean induction through it would be about 1,000 with 20 milliampères current. But the so-called saturation point of iron is about 20,000 lines to the square centimetre; thus it will be seen that the cores of telegraph relays are but weakly magnetised. It is for this reason that the inductance of telegraph relays increases as the current with which they are magnetised. This will be evident from the following measurements of the inductance of a B standard relay, the coils being in multiple arc.

Current in milliampères.	Inductance in henrys.
30	·74
25	·735
20	·73
18	·725
15	·72
12	·71
10	·7
8	·64
5	·67
3	·64
2	·6
1	·54

Although all P.O. telegraph relays are made from templates, the unavoidable slight difference in the airspaces between the pole pieces of the different relays makes their inductance vary somewhat. Some relays having 4/3 the inductance, or even more, that of others.

Obviously, the greater the proportion of the whole of the flux of induction that passes through the tongue, the greater will be the efficiency of the relay. But when this result is obtained by having too small an air space, the greatness of the residual magnetism makes the tongue sluggish in its movements.

The pull of the coils upon the tongue is not only proportional directly to the flux of induction, but is inversely proportional to the area across which the flux of induction acts.

Owing to the irregular manner in which the lines of induction flow between the coils and the tongue, it is impossible to calculate the pull that should be exerted by taking the flux of induction from each source.

The pull of the coils of a relay is proportional to the current strength, within the limits of the current strength generally used.

The intensity of magnetisation of the magnets used in the telegraph service varies considerably, an average value being about 100 C.G.S. units.

The number of lines of induction that pass from the permanent magnet to the tongue of the relay varies, of course, with the distance of the magnet from the tongue. Of the 2,000 lines that emanate from the end of the magnet, only about 1,000 would pass into the tongue, even when the magnet was as close as possible to it, and when at a millimetre distance only 500, or a quarter of the whole.

The Sounder.

The P.O. sounder has a core with a sectional area of about 1·13 sq. centims., and is wound to about 1,600 turns of wire.

The current strength employed varies between 170 and 120 milliampères, according to the condition of the battery. So that the magnetising force given by the formula $\frac{4\pi A}{10}$ is 343 to 242 C.G.S. units.

The induction through the core, of course, diminishes from the bottom of the core to the top, and is least in the armature.

Owing to the spreading out of the lines of induction between the core and the armature, the pull upon the armature is somewhat less than is given by the formula

$$\frac{\phi^2}{4\pi s}$$

where ϕ is the flux of induction through the armature and s the area of the core.

The following table gives the flux of induction and the pull upon the armature measured, a current of 120 milliampères being used.

Play.	ϕ through bottom of coil.	ϕ through armature.	Pull upon armature, in dynes.
Armature on core	7,430	6,460	...
¼ millim.	6,600	5,800	1·5 × 10^6
½ „	5,000	3,920	·65 × 10^6
¾ „	3,570	2,500	·28 × 10^6
1 „	2,860	1,800	·168 × 10^6

From this table it will be seen that the farther the armature is from the core, the more lines of induction are lost by passing between the cores through the air instead of through the armature.

The automatic switch has a core of the same diameter as the sounder, but is wound to 5,500 turns of wire. The current through the coils varies from 100 to 68 milliampères, according to the state of the battery. The magnetising force would therefore be from about 700 to 470 C.G.S. units, or twice that of the sounder. It is, of course, necessary to have a greater magnetising force in the automatic switch, since it has to actuate two armatures, and, therefore, has twice as many air spaces as the sounder through which it must force the lines of induction.

It will be seen from the preceding table that although the core of a sounder is much more strongly magnetised than that of a relay, yet the former is only magnetised up to a third of the so-called saturation point even when it is resting on the cores. Upon a circuit worked by the Wheatstone transmitter the automatic switch is still more weakly magnetised than the sounder, for owing to the continual breaking of the local circuit through the motion of the tongue of the relay, the coils have not time to acquire the maximum magnetisation that would be given to them by a steady current.

Galvanometers.

To determine the constants of a galvanometer it is necessary to know the effective intensity of field that the coils produce with unit current = G, the magnetic moment of the needle = $m\,l$, and the greatness of the antagonistic force that tends to keep the needle pointing to zero. The product of G and $m\,l$ gives the deflecting force. For many purposes it is also useful to know the inductance of the coils.

The intensity of field produced by most galvanometer coils cannot be accurately calculated, but in every case it can be readily measured by comparing the action of the coils upon the needle with that of a narrow tangent coil whose intensity of field with one ampère of current is given by the formula

$$G = \frac{2\pi n}{(y_2 - y_1)\,10} \log_\epsilon \frac{y_2}{y_1}$$

where y_1 and y_2 are the internal and external radii of the coil.

If the galvanometer coil is placed within the tangent coil and they are joined up to two resistance coils and the same battery, and the resistances are adjusted until the effect of the two coils upon the needle is balanced, then the effective intensity of field produced by the galvanometer is

$$\frac{R_g}{R_t}\,G_t = G_g$$

The intensity of field at the centre of a bobbin such as that used for a reflecting galvanometer may be approximately calculated. The intensity of field produced by a turn of wire of radius, y, at a point along the axis at a distance, x, from its centre with one milliampère current is

$$G = \frac{2\pi y^2}{10\,(x^2 + y^2)^{\frac{3}{2}}}$$

hence the intensity of field produced at the centre of a coil having a breadth $2x$, and internal and external radii, y_1 and y_2, and n turns of wire, would be n times the mean effect of all the turns of wire.

$$G = \frac{2\pi n}{10} \frac{\int_{y_1}^{y_2}\int_{-x}^{x} \frac{y^2}{(x^2+y^2)^{\frac{3}{2}}}\,dx\,dy}{\int\int dx\,dy}$$

$$\therefore G = \frac{2\pi n}{10\,(y_2 - y_1)} \log_\epsilon \left(\frac{y_2 + \sqrt{x^2 + y_2^2}}{y_1 + \sqrt{x^2 + y_1^2}}\right)$$

This formula reduces to that of a tangent coil when $x = 0$.

The effective intensity of field of the ordinary differential galvanometers varies somewhat with the different patterns, being from ·7 to ·4 C.G.S. units per milliampère current, the coils being in series. The value of G in a single coil reflecting galvanometer wound to 100 ohms is about ·6 per milliampère current. And in the P.O. tangent galvanometer ·1 per milliampère current.

To determine the magnetic moment of the needle of a galvanometer the galvanometer should be placed bodily above or behind a reflecting galvanometer, the needle being at a distance of r centimetres from the mirror. If, then, the deflection, D, of the mirror be measured when the needle is moved through 180° from east to west or west to east, the magnetic moment of the needle will be—

$$\frac{r^3\,D}{2}\,H = \frac{r^3\,D}{2}\,\frac{G\,c}{d}$$

where d is the deflection of the mirror produced by a current, c, through the reflecting galvanometer of constant G, when the galvanometer under trial is in position.

The magnetic moment of the needles of P.O. galvanometers vary much, being from 20 to 45 C.G.S. units for the canoe paddle-shaped needle and 10 to 20 C.G.S. units for the horseshoe pattern needle.

The moment of force between the coils and the needle, that is the pull of the coils on the needle at unit distance from the pivot, is equal to the product of the magnetic moment of the needle and the effective intensity of the field of the coils. This value, of course, varies considerably in the different galvanometers, being from 14 to 30 with the canoe paddle needle and 5 to 8 with the horseshoe needle with 1 milliampère current through the coils in series. These values are the moments of force when the needle is at rest; they, of course, become smaller the farther the needle is deflected.

Knowing the moment of force between the coils and the needle it is not difficult to calculate the amount to which the lower end of the needle must be weighted so as to produce a certain deflection with a given current, Thus the canoe paddle needles are weighted with from 1·5 to 4·5 grains at an inch distance from the pivot, and the horseshoe pattern needle with about ·6 to 1·2 grains at an inch distance from the pivot according to the greatness of the moment of force between the coils and the needle.

In the tangent and mirror galvanometers

$$c\,\frac{G}{H} = \tan d$$

where H is the intensity of the directing field and G the constant of the galvanometer. In the P.O. tangent galvanometer, H is adjusted to ·145, so that

$$\frac{\cdot 1}{\cdot 145} = \tan 34\tfrac{1}{2}^\circ$$

this is equal to a deflection of 40 tangent divisions upon a scale of 60° divided into 100 such tangential divisions.

In the reflecting galvanometer as in the tangent galvanometer the force directing the needle to zero is the earth's field. But this force is much weakened by the use of the controlling magnet. For ordinary purposes it is not advisable to use a directing field of less than a tenth to a twentieth that of the earth. Suppose the directing field is ·02 and the galvanometer is wound to 100 ohms. Then

$$c\,\frac{G}{H} = \tan d \therefore c\,\frac{600}{\cdot 02} = \tan d \therefore c\ 30{,}000 = \tan d$$

where c is the current in ampères and d the angle described by the mirror, not the spot of light.

It is often convenient so to graduate and place the scale that the deflection of the spot of light divided by 1,000 or 10,000 gives the tangent of the angle of deflection of the mirror. Thus the deflection upon a scale graduated to $\frac{1}{16}$th of an inch and placed $34\frac{1}{4}$ inches from the mirror, should be divided by 1,000 to determine the tangent of the angle of deflection of the mirror. With this arrangement of the scale in the above example

$$c = \frac{d}{30{,}000{,}000}.$$

Similarly with a scale graduated to $\frac{1}{2}$ millimetre and placed $2\frac{1}{2}$ metres from the mirror, the deflection upon the scale is 10,000 times the tangent of the angle of deflection of the mirror.

In balancing a duplex circuit the greatest difficulty experienced is with the adjustment of the condensers and retardation coils; moreover, the speed of automatic duplex working is limited principally by the static charging of the line, hence it is important that the galvanometer should give as large an elongation as possible with small discharges. That is, it is important that the ratio of the elongation to the quantity of discharge producing it, should be as great as compared with the ratio of the deflection with a steady current to the current producing that deflection. That is

$$\frac{\frac{\epsilon}{q}}{\frac{d}{c}}$$

should be as large as possible.

This constant with a horseshoe pattern needle is eight as compared with six with a canoe paddle needle. The advantage of the horseshoe needle being due to its lighter weight.

The conditions that make $\frac{\frac{\epsilon}{q}}{\frac{d}{c}}$ a maximum may be obtained thus:—

$$d = c\,\frac{G}{H}$$

where d is the deflection, G the galvanometer constant, c the strength of current, and H the intensity of the directing field. Also

$$\epsilon = q\,\frac{\pi}{t\,c_1}$$

where t is the time of a semi-vibration, and c_1 the current that produces unit deflection. And since $t = \pi\sqrt{\frac{K}{M\,H}}$ where K is the moment of inertia and M the magnetic moment of the needle

$$\epsilon = q\,G\,\sqrt{\frac{M}{K\,H}}$$

$$\therefore \frac{\frac{\epsilon}{q}}{\frac{d}{c}} = \sqrt{\frac{M\,H}{K}}$$

If, however, the antagonistic force is not a directive field, then

$$d = c\,\frac{G\,M}{H_1}$$

where H_1 is the antagonistic force.

And

$$\epsilon = q\,G\,M\,\frac{1}{\sqrt{K\,H_1}}$$

$$\therefore \frac{\frac{\epsilon}{q}}{\frac{d}{c}} = \sqrt{\frac{H_1}{K}}$$

Hence it will be seen that the directive field and the magnetic moment in the one case, and the other antagonistic force in the other case, should be made as great as possible as compared with the inertia of the needle.

ELECTROSTENOLYSIS.

OUR issue for July 24th, 1891, contained a short notice of some curious researches in electrolysis which had been made by F. Braun. These were described at length in the *Annalen der Physik und Chemie* [2] xlii., pp. 450—464.

It may be remembered that these experiments were a development of some observations made by Grotthus [described in Gilbert's *Annalen*, lxi., p. 65] upon the phenomena of the decomposition of an electrolyte in a narrow crack through which a current passes. Braun promised further research upon the subject and this promise he has fulfilled; there is a paper by him in which more observations are recorded under the curious heading "electrostenolysis."

Electrostenolysis is the name invented by Braun and applied by him to the phenomena we are considering. He states that it is best observed in the case of solutions of salts of the heavy metals, for these metals are deposited in the crack as on an electrode.

The experiments, as before, were made by passing an electric current through two solutions of an electrolyte communicating with each other only by means of a crack in the glass tube containing one of them, the positive pole being immersed in the external vessel which contains the other solution.

The following substances in solution have been decomposed in this apparatus, namely, silver nitrate (this substance was the one examined originally by Grotthus), lead acetate, lead nitrate, auric chloride, cobalt nitrate, palladium nitrate, platinum chloride, and ferrous sulphate.

The phenomenon of electrostenolysis was not observed in the case of copper salts except when they were used in ammoniacal solutions. Salts of zinc, nickel, bismuth, the alkalies and hydrogen showed no action.

As the current passes, bubbles of gas may be seen in process of formation in the crack, which pulsates as the bubbles increase in size, and are liberated on reaching the surface. In the dark sparks may be observed within the crack.

The breadth of the crack need not be very small, for the phenomenon was observed in one of 0·06 mm., but it could not be observed in very wide slits. Neither does it matter whether glass, mica, or any other convenient substance be used, for the material in which the crack is made seems to have no influence whatever upon the result; but the phenomenon does not appear in membranes, whether of animal or vegetable origin, neither is it seen in porous cells nor in hydrophane.

Electrostenolysis cannot be obtained if the current density be less than a certain definite amount.

With these observations we may compare some by the same author, and described in the same number of the *Annalen*, pp. 501—509, and entitled "Electrocapillary reactions."

Some time ago Becquerel observed that if a crack about 0·06 mm. in breadth be made in a glass tube, which is filled with a strong solution of sodium sulphide, and dipped into a concentrated solution of cupric nitrate, metallic copper is, after a while, deposited on the edges of the crack, and that this deposit is covered later by a layer of cuprous oxide, which gradually grows into the crack, and may eventually burst the tube.

The same phenomenon has also been examined by W. Ostwald (*vide Zeitschrift für Physikalische Chemie*, vi., pp. 71—82) in a paper entitled "The Electrical Properties of Semi-permeable Walls," which was noticed in the ELECTRICAL REVIEW for January 9th, 1891. In this paper he gave an explanation of Becquerel's phenomenon, which is based on the properties of semi-permeable membranes towards various ions. He said, in effect, that the copper sulphide first formed allows the passage of the NO_3, but not of the Cu ions. The NO_3 ions coming in contact with the sodium sulphide, brings about, in his opinion, the following change, namely:

$$\begin{array}{cccccccccc} 2\,NO_3 & + & 2\,Na_2 & S & = & 2\,Na & NO_3 & + & K_2 & S_2 \\ 2\,(-) & & 4\,(+) & 4\,(-) & & 2\,(+) & 2\,(-) & & 2\,(+) & 2\,(-) \end{array}$$

and said that if the positive and negative charges be counted, it will be seen that there are six negative and four positive before, and four negative and four positive after the reaction. He considered that the negative charges set free combine with the positive charges of the Cu ions on the other side of the film, and the copper is thus deposited.

Braun, however, is of opinion now that what really takes place is that a galvanic element is formed by the following substances:—

$$Cu\,S \mid Cu\,(No_3)_2 \mid \text{basic salt} + Na\,NO_3 \mid Na\,H\,S \mid Cu\,S,$$

and that this element occasions the deposition of copper at the crack; he supports his contention by some well-considered arguments.

GEARLESS TRAMCAR MOTORS.

THE idea of placing an armature upon the driving axle of an electrically propelled vehicle is an old one; but it did not obtain a practical application until about two years ago, when the first of the locomotives for the City and South London Electric Railway was built by Messrs. Mather and Platt. It was not a very difficult task to design motors for railway locomotives running at the rate of 20 miles per hour, and capable of developing upwards of 50 horse-power. But when it came to the question of machines for tramcars whose axles revolve at 100 or less revolutions per minute, then engineers preferred to keep to the beaten track of using some kind of reduction gear between the armature and the car axles. The problem has entered into every traction engineer's mind; one and all have made calculations as to the possibility of constructing slow speed motors of reasonable dimensions, weight and efficiency. If weight had been no object, dimensions and efficiency seemed to bar the way to the adoption of this desirable mode of electric traction. Another point which deterred pioneers was the fear that an armature, keyed directly upon a car axle, would soon shake to pieces.

An American, Prof. S. H. Short, whose name is familiar to our readers, had the courage of going beyond mere calculations and surmises, and he has for a considerable time been engaged upon experiments with gearless motors. The Westinghouse Company, of Pittsburgh, also, has been working in the same direction, but until recently we have had little or no definite data relating to the performances of such motors, which now form the theme of a paper read by Mr. Short before the Chicago Electric Club. We have on previous occasions referred to the ingenious method which Mr. Short devised for flexibly supporting his motor so as to avoid the direct transmission of shocks to the armature. This armature is mounted on a hollow shaft which surrounds the axle, leaving an air space of about an inch all round the axle. This hollow shaft is carried in its own independent bearings in the motor frame forming part of the field magnets. At one end of the hollow armature shaft is a flexible driving device connected to the car axle. The motor somewhat resembles a Schuckert dynamo with as large an armature as the space under the car will admit. What interests us most at this moment, however, is the efficiency which Mr. Short obtained with his gearless motor, and with geared motors, and for this purpose we use his own language in referring to the various tests. "When we first took up the subject of a gearless motor, we set about to see how much could be gained in the efficiency of transmission of power by doing away with the gears. I made a very careful and thorough investigation of the losses between the armature pinion and the intermediate gear, and between the intermediate pinion and the axle gear, of a double reduction motor. I first put a double reduction motor in good order, eliminating the armature bearing losses as much as possible by running the motor for a long time, to wear the bearings down to a good surface. I put my power brake for determining the horse-power directly on the armature shaft and ran my motor, delivering different horse-powers all the way from no horse-power to its full output—20 H.P. At the same time we measured the electrical horse-power which was being put into the motor, and from this we constructed a curve of efficiency of the motor at different loads. The greatest efficiency reached by this motor was about 70 per cent. at a load of from 14 to 16 H.P. The efficiency at small loads, say, at 2 H.P., was something like 50 per cent.; at 4 or 5 H.P. an efficiency of 65 to 70 per cent. We then took the brake from the

armature shaft and replaced it with a well made armature pinion, allowing it to mesh with a well made intermediate gear, these gears being cut as nicely and as carefully as possible, so that there would be the least possible loss between the two in making this test. Putting the brake on the other end of the intermediate shaft, we again secured the readings of the horse-power delivered." Summing up, Mr. Short says: "It will be seen that the efficiency of the gearless motor at the axle, when delivering 14 H.P., reached very nearly 70 per cent., or very nearly the same efficiency as the double reduction motor at the armature shaft. The single reduction motor, when delivering the same power through one pair of gears, showed an efficiency of 60 per cent., while the double reduction shows a little over 50 per cent. These practical tests show that, with the gearless motor, we actually save 15 to 20 per cent. in the power it is necessary to put into the car in order to get the same results at the axle."

These were laboratory tests. Referring to actual runs with cars on roads in the city of Cleveland, Ohio, Mr. Short admits that simultaneous readings have shown that in some cases the single reduction motor would require the least amount of current, sometimes the double reduction, and sometimes the gearless motor, depending upon the number of passengers hauled, stops made, and other things; so it is difficult to say that there is any difference in actual power consumption between the three classes of machines.

These tests are by no means conclusive. No mention is made of the types of motors which were brought into competition with Mr. Short's own machine. Two things struck us when examining the curves. One is that as high an efficiency as 70 per cent. could be obtained with the gearless motor, and the other curious phenomenon is, that with all the motors the efficiencies fell off rapidly when the motors were yielding less than 10 or 11 H.P. Considering that in most cases two such motors are placed upon a tramcar, and that with ordinary speeds in cities the power on the car averages about 6 to 7 horse-power, or 1 H.P. hour per car mile measured at the terminals of the motor, it seems to us that there is some deficiency in the design, at any rate, of the machines used in Mr. Short's experiments. What should be aimed at in traction motors is not a high efficiency at one particular speed and load, but a good all-round efficiency within a wide range of loads and speeds, and this has been attained by engineers in England. We tested motors in London several years ago which gave an *average* efficiency within a range of from 2 to 12 H.P. of over 70 per cent., and these we believe have been still further improved.

The Thomson-Houston System.—The total number of Thomson-Houston arc lights in use in America is over 100,000. Of incandescents there are over 800,000; 2,769 cars are also equipped with the company's railway motors.

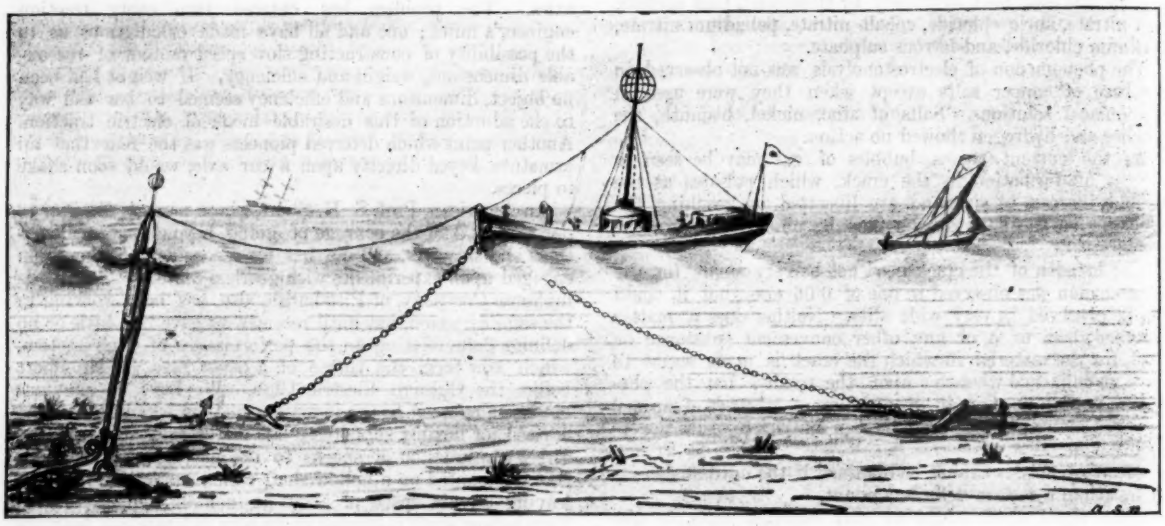
ELECTRICAL COMMUNICATION WITH LIGHTSHIPS.

The suggestions on this subject which we published in our issue of the 1st inst., seeming to have attracted a considerable amount of attention, we now give an illustration showing one of the proposed methods of establishing communication with a lightship by means of a spar buoy; the lightship being moored in the way generally adopted by the Trinity House.

The use of an ordinary buoy for this purpose has been proposed many times before. The *Liverpool Journal of Commerce*, of February 12th last, published in a supplement a sketch of a lightship riding to a single anchor and chain cable with a telegraph cable taken on board, kept clear of the ground and away from the mooring by supporting it under the bottom of an ordinary buoy moored to the same anchor as the lightship.

This arrangement does not seem to us to be a good one, as the movement of the buoy in a seaway would cause a great amount of wear and tear to the cable whatever might be the special means provided for supporting it under the buoy.

By the use of a spar buoy all such wear and tear is obviated, since the bottom of such a buoy has practically no movement whatever. In fact, experience in New York harbour has shown that there is no difficulty in maintaining communication to at least as far as the top of a spar buoy, and this, to our mind, is half the battle.



On the lightship special arrangements would have to be provided to enable the ship to swing completely round without fouling the cable, as well as an automatic machine, such as is now, we believe, in actual use for towing purposes, for easing out the telegraph cable when strain comes on, and recovering it as soon as it slackens. That everything should work automatically, as far as possible, is very necessary, so long as the Trinity House gives no assistance in the matter; but the difficulties are, on this account, much greater than they need be.

Whether or not it is necessary for lightships to be moored by two anchors is a question we must leave to others to decide. There are, perhaps, some cases where a single anchor, as has been suggested for the Mersey Bar lightship, would suffice, in which case the difficulties would become very much lessened, and we should advise that the ship should be moored to the spar buoy just in the same manner as to an ordinary mooring buoy; in bad weather, chain and telegraph cable being veered away together. Lucas's method of enclosing the cable in a double-linked chain would be very suitable for this case.

Among possible developments of the use of the telephone will undoubtedly be that of communication between ships at their permanent moorings and offices on shore, and this seems to offer a large field. Such a system has been actually in use in Marseilles Harbour for some time, we believe, but has not yet been adopted in this country. For this a spar buoy in some form or other seems peculiarly suitable.

PARLIAMENTARY NOTES.

COAST COMMUNICATIONS.

IN the House of Commons on Tuesday, April 26th,

Sir E. BIRKBECK rose to move the following resolution standing on the paper in his name:—"That, with a view to the better prevention of loss of life and property in case of vessels in distress or shipwrecked on the coast of the United Kingdom, and to give the earliest possible information to lifeboat authorities and rocket apparatus stations, in the opinion of this House it is desirable that all coastguard stations on the sea coast and signal stations should be telephonically and telegraphically connected by Government, and that on those parts of the coast where such stations do not exist, the post offices nearest to the lifeboat stations be telephonically or telegraphically connected, and that a Royal Commission be appointed to enquire into the desirability of connecting certain light-vessels and rock lighthouses by cable with the mainland, in order to give information of vessels in distress." He said that the House would not turn a deaf ear to the appeal made by the seafaring community that Parliament should sanction a most necessary provision for the preservation of life and property round the coast. It might be thought that in consequence of the answer of the First Lord of the Treasury to a recent question, it was unnecessary to bring the matter forward; but it would be more satisfactory to deal with the question briefly in debate, so that both sides might have an opportunity of considering the proposals he had to make. It would be a matter of general surprise that Great Britain was so behind-hand in the adoption of means for the better preservation of life and property at sea. He did not wish to condemn any Government; but, inasmuch as the Board of Trade officials were bound to institute inquiry into every disaster on the coast, there must be pigeon-holed at the Board of Trade offices a very great number of reports; and it would be a matter of public interest to know to what extent the Board of Trade officials had from time to time brought pressure to bear on the various Presidents of the Board of Trade to take some steps in the matter dealt with by the present motion. The responsibility for this question of loss of life had been shunted from one Government department to another, and the Trinity House had in the past especially acted as a buffer to the Board of Trade, while it had been handicapped to a great extent by the fact that it had not been liberally supported by Parliament. Great Britain was in the unfortunate and humiliating position of having to admit to the world that Denmark, with her import and export trade of 30 millions, had carried out successfully a system of coast communication, while she herself had done nothing, though her import and export trade amounted to 743 millions. In the resolution he had divided the question into two parts. The first referred to communication proper, and the second to communication by cable with the floating light vessels and rock lighthouses. As experiments had been carried out with reference to the latter subject, he would deal with that first. Communication with the outlying light vessels and rock lighthouses involved serious engineering and financial questions, and, therefore, it ought to be considered in the first instance by a Royal Commission. The practicability of this communication had been absolutely proved, and cable communication with the Sunk light-vessel, off the Essex coast, was established in December, 1884. In 1887, the then President of the Board of Trade appointed a departmental committee to enquire into the advisability of continuing cable communication with the Sunk light-ship. He, himself, served on the committee, and, together with Colonel King-Harman, found himself in a helpless minority. He was obliged to draw up a minority report, because the committee decided that the maintenance of the communication was not desirable, it having involved considerable expense, and produced but little result in the saving of life. He had never regretted his action in that matter. He strongly declared his opinion at the time that the experiment ought to have been carried out for a further five years, and that Parliament ought to have voted a further sum for experiments. During the trials that were made there were no bad gales, and exceptionally few cases of disaster on the neighbouring sands. The Trinity Corporation were adverse to the experiment, because they thought the money might be better spent; and they were particularly influenced by one fact which was brought out in evidence. On one occasion the lightship was hailed by a passing vessel, the master of which, a newly married man, desired that a private message should be delivered to his wife on shore. It was, however, clearly proved that the officers of these lightships were perfectly capable of undertaking the entire duty of working cable communication. The men on board these light-vessels were perfectly able to work the telephone, and having visited one of the ships himself, he was able to say that it was just as easy to speak through the telephone from them as it was to speak through the telephone on the mainland. In case of snowstorms or fogs, when rockets could not be seen from the mainland, the officer in charge of a light-vessel could tell the exact position of any ship in distress, and thus serious delay in sending aid was avoided. He quoted extracts from the telephonic messages which had been received on the mainland through the sunk cable, in which the exact position of the vessels in distress was clearly described, and called attention to several cases in which the existence of coast communication would in all probability have prevented serious loss of life. The first case mentioned by the hon. baronet was that of a vessel lost on Easter Monday off the coast of Norfolk, eight miles from the shore. The vessel, which had come from the Baltic, bound for Lynn, was seen in distress by the watch at 10 o'clock in the morning. The lifeboat was launched, and she had eight miles to go dead to windward and in a gale of wind and a heavy sea. Had there been telegraphic or telephonic communication, the coastguard could have sent a message to Skegness, on the Lincolnshire coast, whence a lifeboat could have been despatched direct to the vessel. In that way there would have been a saving of at least three hours in the arrival of help, and in all probability the seven lives which were lost, out of a crew of eight, would have been saved. As it was, the Norfolk lifeboat was able to rescue only one of the crew. He mentioned the case of another vessel which was stranded on the Kentish Knock, with 230 persons on board. Of these, 173 were saved by a tug, while 57 were lost. Guns and signals of distress were fired, but they were not seen or heard for 13½ hours, and the occurrence was not known at Harwich until 13½ hours after the vessel had been wrecked. The lifeboat from Broadstairs arrived too late to save any of the 57 lives, but had there been cable communication they might undoubtedly have been saved. The case of the *Indian Chief* was another to which he alluded. She was wrecked on the Long Sands, off the Essex coast, in 1881. Out of a crew of 29, 12 were saved by the Ramsgate lifeboat, while 17 were drowned, owing, no doubt, to the fact, that something like 28 hours elapsed before the lifeboat arrived at the scene of the wreck. On December 11th last the steamship *Enterkin*, of Glasgow, was wrecked on the Galloper Sands, 30 miles from Ramsgate, and out of a crew of 30, 27 were lost. The vessel was wrecked at five o'clock in the evening. The crew were lashed to the rigging, and it was not until three o'clock the next morning that a fishing boat passing the wreck saved one man, while two others were rescued by another vessel. There were many other cases in point, but he need not refer to more than these three. The question as to which light vessels and rock lighthouses ought to be placed in telegraphic communication with the mainland was a matter for inquiry by a Royal Commission. The Fastnet, the Tusca, the Eddystone, and other rock lighthouses were undoubtedly all points of very great importance, and as regarded the Fastnet, where the communication had been broken, the evidence given before the Departmental Committee of the Board of Trade proved that there was no difficulty whatever, from an engineering point of view, in carrying out this proposal. He had taken up the question of coast communication proper on behalf of the lifeboat service and the rocket apparatus service, because it had too often occurred that when the lifeboat or rocket apparatus got to the spot where a wreck had taken place, they found only pieces of the wreck left, and possibly the dead bodies of the crew. All that the lifeboat crews and the men in charge of the rocket apparatus asked for was that there should be as rapid communication as science could possibly invent. He also referred to the case of the steamship *Lymington*, lost in 1889, on the north coast of Devon, and to the case of the *Schiller*, wrecked on the Scilly Isles in 1875, in both of which instances loss of life was, he said, clearly due to the absence of communication. There had been instances in which as many as six lifeboats had gone out to one case of distress, when if there had been cable communication, it was probable that only one lifeboat need have gone out. At all events, telegrams would have given the information that one lifeboat had been launched and had gone off. Then it was necessary to consider the case of a steamer or vessel passing a headland, and being sighted from the lighthouse, where men could see that she was being driven before the wind, and was approaching too near the shore. It might then be too late to get out the adjacent lifeboat, because the vessel would be driven too far for the lifeboat to reach her in time; but if there were another station 10 miles off, a telegram or telephonic message would secure the launching of the lifeboat there, or the sending of tugs to assist the vessel in distress. There had been a number of cases off the coast of Wales in which vessels had been lost that might have been saved if there had been an opportunity of asking for tugs to be sent to tow them in. It had been proved over and over again that a vast amount of property, as well as numbers of lives, might have been saved if coast communication had existed around our shores. One Sunday morning a North German Lloyd steamer, the *Werra*, proceeding down Channel in a fog, ran a quarter of a mile inside Dungeness Point. He was going down the Channel in a yacht, from which a boat was lowered to the *Werra*, whose captain stated that he ran aground about half-past 10 o'clock. Sending a boat ashore at once to telegraph to Dover and elsewhere for the assistance of tugs, he learned that the post office had been closed at 10 o'clock, and would not be opened again till Monday morning. At the captain's request the yacht went to Hastings, whence telegrams were sent off for assistance, and, the water being smooth, the steamer was ultimately got off. After citing other incidents, and further urging the importance of the question, the hon. gentleman moved the resolution standing in his name.

Mr. MARJORIBANKS seconded the resolution.

Sir J. FERGUSSON admitted that in many cases there had been a lamentable want of coast communication when disasters occurred, but pointed out that it was easy to exaggerate the good which might be done by establishing telegraphic communication between coastguard stations. It was obviously impossible by any legislative or administrative action to do away altogether with dangers at sea. The First Lord of the Treasury stated, however, on March 30th, that the Government sympathised with the member for East Norfolk, and hoped to do something substantial towards carrying out the object he had at heart. It might be mentioned that during the last five years the Government had done more than any previous administration to remedy the want of efficient communication. A large number of coastguard stations had been connected with telegraph offices, and, as regards national defence, the Admiralty were now satisfied with the means of communication with the coastguard stations. But the Government, recognising the necessity for an extension of telegraphic communication to exposed parts of the coast, had framed an estimate of the working cost necessary to connect telephonically the coastguard stations from the Isle of Wight to Lynmouth, in North Devon. Exact calculations showed that the cost would be something over £16,000. The matter had now got beyond the stage of contemplation, and the engineers of the Post Office were taking active steps to give effect to the scheme. A rough estimate had also been made of the cost of establishing communication between all our light-

houses and lightships and the shore, and it was calculated that nearly £300,000 would be required for the purpose. It was the intention of the Government to appoint a Royal Commission to investigate, and they gladly assented to the motion of his hon. friend.

After some remarks from Mr. Penrose Fitzgerald, Colonel Hill, Mr. J. Lowther and Lord H. Bruce, the resolution was agreed to.

LEGAL.

The English and Scottish Investment Company v. Brunton.—This case, which involved some difficult and intricate points, was argued some time back before Mr. Justice Charles, when judgment was reserved.

Mr. R. T. Reid, Q.C., Mr. Tyrrell T. Paine, and Mr. Sargent, appeared for the plaintiffs; Mr. A. Cohen, Q.C., Mr. Bremner, and Mr. Le Fanu were counsel for the defendant.

This was an interpleader issue to try the right to a sum of money claimed by both parties in the following circumstances:—The Electrical and Engineering Corporation, Limited, carried on business in premises at West Drayton. These premises they insured with the Sun Fire Office, and a fire having occurred in January, 1891, a sum of over £1,809 was admitted to be due, in respect of the said fire, to them. The Electrical Corporation prior to the insurance had created and issued debentures which gave a floating charge over the whole undertaking, and contained a clause under which the Corporation undertook not to mortgage or charge any part of their property so as to give priority over the debenture-holder. The fire having occurred the Corporation were in need of money, and accordingly applied to the English and Scottish Mercantile Trust, Limited, for an advance on the security of the moneys payable by the Sun Insurance Office. The money was advanced under the circumstances as found by the learned Judge's judgment, and the question was whether the plaintiffs, the English and Scottish Company, were affected by constructive notice of the existence of the condition in the debenture prohibiting the creation of prior mortgages and charges.

On Wednesday last His Lordship delivered judgment for the plaintiffs with costs.

NOTES.

Oil Insulation.—Now that oil insulation and high pressures are so much to the front, it is to be hoped, says *Industries*, that some one who has the means at his command will investigate the whole question and publish his results. The first thing to do is to avoid talking about sparking distances in the usual way. Striking distance should be taken between two plates of such slight curvature that the radius of curvature is large in comparison with the striking distance. The plates should also be so large that the edges are far enough apart to prevent the spark passing there. By this means the number of volts per centimetre needed to "break down" any insulation can be found. To obtain concordant results, the dielectric should be subjected to the same fall of potential throughout the course of the intended spark. The greatest difficulty is experienced in defining the oils. No two samples of oil with the same name seem to be alike.

Technical Instruction.—The report of the Gordon Technical College, Geelong, Australia, states that an electrical engineering class has been in existence for twelve months; during that time the students have made very satisfactory progress. There are now thirteen pupils on the roll, all of whom are tradesmen, and take a great interest in the study of electricity. A complete set of instruments for demonstration has been purchased by the College, and is now in use. The subjects dealt with during the past year have been the means of encouraging the pupils to make small instruments at home during their leisure time. Mr. W. H. Lord, instructor, says:—"I think the pupils should be examined at the end of each quarter by their own instructors. We would then be able to see what progress has been made. At the end of the year the students could be examined by a Government electrical engineer, and certificates awarded."

Electric Launches for the Thames.—Mr. W. S. Sargeant has received an order for a launch from W. T. Crawshay, Esq., of Caversham Park, Reading, Berks, and the boat will be running on the Thames this season. The accumulators to be used are those of the latest type of the Electrical Power Storage Co., these accumulators having proved by practical experience to be the most efficient for water propulsion on the Thames. It seems that the time is not far distant when the electric launch on the Thames will be as common as its steam congener is now.

Brooklyn Telegraph Messengers.—The following note appeared in the New York *Electrical World*:—"Brooklyn reports that a messenger boy in that city on one occasion hurried in delivering a telegram, and as he was not accustomed to it he collided with one of the lamp posts, which ordinarily are such a support for these boys. The result was that the boy was hurt and that the message was delayed in its delivery. He instituted a claim for $10,000 damages against the company. His claim is that it was a hazardous occupation to hurry, but the company will probably win the suit on the plea that he disobeyed orders. The public will not be affected by this because our local telegraph system is so wretched that it is of little use to anybody."

St. Pancras Vestry and Electricity.—The *Gas World* states that to a meeting of the St. Pancras Vestry, held on Wednesday last week, the Electricity Committee reported that it had considered the question of supplying electricity in the day-time for motive power, lighting cellars, for electro-plating, and other purposes. The ordinary average burning of each lamp installed was less than two hours daily, and nearly the whole of this current was required during the early hours of the night. If facilities were afforded for the use of electricity for trade purposes during the day, the resultant increased profit would, it was hoped, enable the Vestry to reduce the price of current for ordinary night consumption, even below the present charge of 6d. per unit. The committee accordingly recommended that consumers should get a day supply of electricity by a separate meter at 3d. per Board of Trade unit, such supply to be provided under proper supervision and regulations to be made from time to time. The committee's report was unanimously adopted.

A Railway Accident.—An action has been brought against the theatre manager, Herr von Bukowicz, concerning a miniature electric railway. A firm of electrical engineers, Mayer and Wolf, of Vienna, sued Bukowicz for payment for an electric railway alleged to have been delivered, which defendant had ordered in 1889 as a Christmas present for his children. As Bukowicz pronounced this electric railway a failure—the electro-motor being insufficient to set the train in motion—the court demanded an "expert opinion" on the incapacity of this electric line. Already a trial trip has taken place in the rooms of the district court, but it went off so unfortunately that a new "day trip" was arranged for, and in the interval a few minor defects in the railway were to be amended. This second trial trip took place, and terminated in an accident. The train ran off the line. This trial trip took place in the hall of the court, in presence of a commission of six persons: the judge, a reporter, two experts in electric installations, and the representatives of the contending parties. A large board, upon which the rails were laid, was fixed in the hall, and the train was set in motion. At first it moved quite seriously along the line, but suddenly the carriages underwent a mighty jolt, the entire train got off the line, and the drama of a "derailment" in miniature was exhibited before the commission. The experts declared that the faulty construction of the rails was the cause of the accident. A third trial trip was, therefore, pronounced requisite, and in the meantime the rails were to be adjusted. The judge postponed the process, and a date for the third trial trip will be officially made known. Never, probably, has a lawsuit concerning children's toys assumed such dimensions as is here the case.

Oil for Fuel at the Chicago Exhibition.—Our American namesake says that in all the large furnaces at the World's Fair Grounds oil is to be used as fuel instead of coal. A contract has been practically made with the Standard Oil Company for furnishing the entire supply. Estimates were given by coal dealers as well, but in comparison oil turned out to be far cheaper. The Standard Company's agents stated that three barrels of oil at 70 cents per barrel of 42 gallons, would produce as much heat as a ton of coal, the cheapest estimate for which was $2.44 per ton. This means, by the use of oil, a saving of 14 per cent. The Exposition Company will pay 70 cents a barrel until 1893, and then have the privilege of getting the oil at the lowest market price, not to exceed 72½ cents a barrel. The proposition will probably be accepted by the Standard Oil Company.

A Steam and Waterproof Incandescent Lamp.—Our contemporary, the New York *Electrical Review*, illustrates a lamp and coupling invented by I. J. Flagg, of Clinton, Mass., which was recently patented. It is claimed that the lamp can be used in steam or under water with perfect success. It is specially designed for use in dye houses, breweries, power mills, tunnels, mines and buoy lighting.

"Electrical Progress and Development."—This is the name under which our late contemporary, *Modern Light and Heat*, now appears at Boston. We hope our contemporary will largely experience, in a journalistic sense, the effects of recent electrical progress and development, and we wish it every success. The journal will be published at the end of each month, and it is intended to be an epitome of the month.

Thomson's Meter Prize Money.—It will be remembered, says the *Electrical World*, that the municipality of Paris some time ago offered a prize for the best electric meter, and that the meter of Prof. Elihu Thomson with that of Aron received the first prize, amounting to 10,000 francs, or about $2,000. Prof. Thomson has just presented the money won by his meter to the Académie des Sciences, of Paris.

Siemens and Halske in America.—Referring to our previous note on this subject, we now hear that the rumour that the Siemens and Halske Company, of Berlin, intended opening an establishment in Chicago is confirmed. The plant, says *Electrical Progress and Development*, it is estimated will represent nearly $5,000,000, and will be devoted to the manufacture of every kind of electrical appliance, including electric railways, dynamos, batteries, lamps, telephones, and everything known in the electrical field.

Sparking in Oil. — The experiments of Prof. Elihu Thomson on oil as an insulator seem to prove that with very high voltages and high periods the insulating qualities of oil are all that can be desired. It appears that momentary contacts are not sufficient to break down the insulation, but that if the alternating waves are kept on for periods from a few seconds to half a minute, the oil may break down at last. Under certain circumstances, it was found that potentials which perforated oil at a distance of $\frac{3}{8}$ths of an inch, failed to do so at a distance of $\frac{1}{32}$nd of an inch.

Yet Another Insulator.—One of the latest proposals comes from Germany. R. Pape considers that his combination of materials is, of course, going to be superior to anything that has yet been introduced to electrical engineers. He mixes three parts of steatite with two of powdered chalk or magnesia and chalk, thoroughly incorporating these ingredients until the material has a uniform "soapy" touch. The mixture can then be compressed into dense masses and is now ready to be worked up into any convenient form. To increase the insulating properties of this prepared chalk, it is kneaded with three parts of resin or shellac dissolved in alcohol until a sort of "dough" is obtained, this is then dried, powdered, warmed with constant stirring to 30° Centigrade, and finally compressed into hot moulds.

Winding Up of the New York Electric Club.—Members of the New York Electric Club have been notified that the winding up of the affairs of the organisation is under consideration by the present management. This decision was arrived at after considering the report of the President on the financial condition of the club and its prospects. The club has for some time past been in a bad way financially. The New York *Electrical World* thinks such a condition of affairs deplorable. The American metropolis should have a flourishing organisation of the character of the Electric Club, and that it has not is a reflection on the public spirit of the fraternity in New York. There is no reason, says our contemporary, why New York should not support a first class electric club. Chicago has an electric club and supports it in a most creditable manner, yet the Chicago Electric Club is much younger than the New York organisation, and has not, in some respects, enjoyed the advantages of the eastern club. Poor management and internal dissensions, it is said, have undoubtedly done much toward hastening the dissolution.

Bazaar Lighting.—A novel bazaar was opened by Lady Nares at the Central Hall, Acton, in aid of the building fund for St. Barnabas Church, the whole bazaar being a representation of the bed of the sea, the stalls being formed by caves, whilst the roof was covered with green gauze to represent the sea. An amusing feature was the descent of a diver in full costume, on whom the beam from a naval search light of over 20,000 candle-power was thrown, all the other lights being switched out for the time; the effect was both astonishing and amusing. The whole of the electrical plant was lent for the occasion by Mr. Ronald A. Scott, M.I.E.E., of Acton Hill, W., the installation being most satisfactorily carried out by Messrs. Cattley, Patey, Hersee, Trollope and MacDonough, pupils at the Acton Hill Electrical Works. Lady Nares congratulated Mr. Scott on the great success of the lighting, without which the bazaar could not have been held, owing to the inflammable nature of the materials.

The Engineering Exchange.—We are informed by the secretary that the Engineering Exchange opens on Monday next, May 2nd, at 12 o'clock. The opening meeting will be in the exchange room of the "Jerusalem," Limited, in Billiter House, Billiter Street, E.C, where the committee have secured preliminary accommodation. All parties interested in engineering are invited to attend at the opening.

Purification of Sewage.—Messrs. Peter Spence and Co. write to us :—"The figures quoted in your issue of the 22nd, from a paper read by Mr. Barrow on the purification of sewage by precipitation are really scarcely worth recording, because the results compared have been obtained under such widely different conditions that no comparison is possible. This will at once be evident when these conditions are stated. For instance, the results of the 'Clarine' process are merely those from laboratory experiments finishing with *filtration through filter paper*. The Electrical Company and the International Company dealt with about 100,000 gallons per day, and passed their effluents through newly constructed filters. The aluminoferric process dealt with 10,000,000 gallons per day without any filtration whatever. Your readers will at once perceive that the supposed comparison is of no value at all."

Elmore's French Copper Company.—The meeting of this company seemed to savour more of the vapourings of a mutual admiration society than that of a business gathering. How shareholders can be satisfied to adopt the policy of the Directorate on the strength of such assurances as those of the Chairman, M. Secrétan, and Major Jones, is entirely beyond our comprehension. Samples of the Elmore manufactures apparently appeal as readily to the shareholders as actual business done, of which, however, we fail to find a single example. But the 40 per cent. dividend which is looming before the eyes of investors in the parent company will doubtless have the effect intended, and enable the Elmore process to urge on its wild career yet a little longer.

Personal.—Mr. John Hamilton Ward having resigned the management of the Electrical Engineering Company of Ireland, Limited, was entertained by the chief officers of the company at a farewell supper held at the Grosvenor Hotel on Saturday, the 23rd inst., to bid him good-bye, and express their appreciation of him, and of the cordial relations which always existed between himself and the staff. Mr. A. A. Davies undertakes the duties of manager in addition to those of secretary, and Mr. Arthur Handley, A.I.E.E., lately assistant engineer, becomes assistant electrical manager.

Mr. Albion T. Snell has been invited to serve on the jury at the Crystal Palace Electrical Exhibition in Section III. (Dynamos and Motors).

The Isle of Man International Exhibition.—This exhibition, to be held at Douglas from July to September this year, is to be lighted throughout by electricity, and with laudable foresight, the promoters, having in view the probability that the exhibition will be the first of a series to be held in the same buildings, have determined to make the electric light installation a permanency. The contract is in the hands of the Brush Electrical Engineering Company, Limited, who have undertaken to have everything in readiness by July 4th.

Church Electric Lighting.—It is proposed to build a new church at Oystermouth and light it with electricity.

Electric Light in Newspaper Offices.—The office of *The Mumbles News and Gower Chronicle* (Swansea) is lighted by electricity.

Aberdeen and Electric Lighting.—The Gas Committee of Aberdeen Town Council have resolved to recommend that the preliminary steps towards the adoption of the electric light should be proceeded with.

The Royal Society.—The following papers were down for reading before this Institution last night:—"On a Decisive Test Case Disproving the Maxwell-Boltzmann Doctrine Regarding Distribution of Kinetic Energy," by the Lord Kelvin, P.R.S.; "On the Mathematical Theory of Electro-magnetism," by A. McAulay.

Country House Lighting.—Viscount Cantelupe has decided to dispense with gas and put the electric light into his new house at Bexhill. A gas engine plant is being installed by Messrs. Drake and Gorham.

Fire at Chemical Works.—The Bellshill Chemical Works and Soap Factory, near Coatbridge, belonging to Messrs. Barr, were destroyed by fire last Friday afternoon. A large quantity of electric lighting plant was destroyed. The damage is estimated at about £4,000.

The Electric Light Wanted at Tunbridge Wells.—A numerously signed memorial has been forwarded to the Lighting Committee of the Tunbridge Wells Corporation, asking them to introduce the electric light for street and shop purposes. The memorialists assure the committee that many shops and houses of business would adopt the light if the Town Council would place it at their disposal. The matter will, it is anticipated, engage the attention of the council at an early date.

The Electric Light in Spain.—The central station at Santander, in Spain, was put in operation at the commencement of last month. The principal streets are now lighted electrically, as are also the principal cafés and clubs.

The Spread of Science.—This is the title of an article in a contemporary, dealing with the "wondrous strides of electricity." The spread is indeed marvellous, for we read that Prof. Elihu Thomson is an Englishman, retained by the Laing, Wharton & Down Construction Syndicate, and established in a large laboratory at their works in America. Perhaps, however, as the Americans have claimed Prof. Hughes, the turning of Prof. Thomson into an Englishman is only a *quid pro quo*.

Practical.—Dr. Louis Duncan, of the electrical department of Johns Hopkins University, Baltimore, U.S.A., has arranged to conduct a ten days' excursion of the electrical students of the University to visit most of the leading stations in the East of the United States. The party was to leave on the 25th inst., and will visit New York, Newark, Elizabeth, South Bethlehem, Reading, Philadelphia, and Wilmington, returning to Baltimore on May 5th.

Electrical Engineering in Germany.—The Actiengesellschaft für Elektrische Glühlampen (Seel), of Berlin, made a net profit last year of £3,700, which allows a dividend of 1 per cent. on the preference shares.

The Electrical Industry in Russia.—Two Russian engineers, have obtained the necessary permission from the Czar to form a company to be known as the Société Electrotechnique Franco-Russe. The object of the company is to erect works at Moscow for the manufacture of all kinds of electrical machinery, and also to undertake the construction of electrical tramways, telephonic systems, electric light stations, &c.

Society of Arts.—On Wednesday, May 4th, at 8 p.m., a paper on "The Bradford Corporation Electricity Supply" will be read by Mr. James N. Shoolbred. Mr. W. H. Preece, F.R.S., will preside.

Telegraphic Communication with Lighthouses.—The Government has given orders for telegraphic communication from Ilfracombe to be extended to Woolacombe and Morthoe, close to the Bull Point Lighthouse and Morte Stone, two dangerous points in the Bristol Channel. It is then intended to carry the wire to Lundy Island, by way of Baggy Point.

The Regent's Park Electric Light Station.—The whole output of this station is now being consumed. To mark this event, the Electricity Committee invited, on Wednesday last, the members of the Vestry to inspect the plant. We believe we can say with truth that the whole of the parish of St. Pancras is well satisfied with the efforts of the Vestry to introduce the electric light.

Prize for a New Primary Battery.—The favourable reception which inventors have given to the International Concourse with reference to the prize of 2,000 francs offered by *L'Elettricita* for a new primary battery, leads to the hope that the competitors will be numerous; but the economic condition that the new electro-motor shall not work at a greater cost than 1 franc per kilowatt-hour, makes it probable that many will hesitate to attempt the problem. The Directorate of *L'Elettricita* now announces that the nearest approach to the condition laid down will be considered, and propositions will be made with reference to the patenting and manufacturing of the successful batteries.

A Trial by Telephone.—American lawyers are busily debating as to the legality of a trial that has lately been held in Ohio. The defendant was prevented by illness from appearing in court, and was consequently examined by means of the telephone, the decision of the judges being conveyed to him by the same channel.

W. T. Goolden & Co.'s Staff Smoking Concert.—This concert was held on Friday evening last at the "Swallow," Swallow Street, Piccadilly, Mr. Ll. B. Atkinson, in the unavoidable absence of Mr. W. T. Goolden, being in the chair, when a large company of the staff and friends assembled, and spent a most enjoyable evening. A variety of songs, sketches and recitations were given, and the proceedings, which continued to a late hour, were concluded by a vote of thanks to Mr. T. Clarke and others who had assisted in arranging the concert, and to the performers who had so ably supported him.

Electric Lighting Question in Moffat.—The Moffat Police Commissioners had before them, on Monday night, a report by Prof. Jamieson, Glasgow and West of Scotland Technical College, upon a proposal to light the streets of Moffat by electricity. Eventually a motion by Bailie Knight to postpone further consideration of the schemes till after the election in November, was carried as against one by Mr. Brown for an immediate appeal to the ratepayers.

New Telephone Exchange.—The Postmaster-General has decided to open a telephone exchange in Berwick-on-Tweed in connection with a telephonic trunk wire from Newcastle to Edinburgh.

Threatened Strike of Telegraphists at Madrid.—A *Standard* telegram on 24th inst. stated that the agitation among the telegraph clerks in Madrid, in consequence of the proposal of the Marquis de Mochales, Postmaster-General, to amalgamate the postal with the telegraph service, continues unabated. Should the scheme be carried out, the whole staff of the Telegraph Department would be placed on the same footing as regards promotion, pensions, &c., as the Post Office officials. The telegraphists, however, only number about 2,000, while there are about 5,000 Post Office clerks, and, therefore, if they are formed into one corps, and promotion takes place by seniority, the telegraphists will be heavy losers by the arrangement. Should they carry out their intention of going out on strike on May 1st, the Government would be placed in a difficult position, as the Madrid telegraphists have the support of their colleagues throughout Spain. In Madrid the Government might put on the military telegraphists, but as the offices in the provinces would be closed, their services would be of very limited use.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Corlett Electrical Engineering Company, Limited.—The registered office of the above-named company is situate at Rowbottom Square, Wigan, Lancashire. (Filed on the 13th inst.).

Association for the Protection of Telephone Subscribers, Limited.—The registered office of this company is situate at 58, Coleman Street, E.C.

Tayler-Smith Electric Company, Limited. — The statutory return of this company, made up to November 5th, 1891, was filed on the 10th ult. The nominal capital is £6,000, divided into 300 6 per cent. preference and 300 ordinary shares of £10 each; 259 preference and 300 ordinary shares have been taken up, and the ordinary shares have been issued as fully paid. Upon the preference shares £2 10s per share has been called, resulting in the payment (including amounts paid in anticipation of calls) of £1,257 10s. Registered office, 53, South Molton Street, W.

Cambridge University and Town Electric Lighting Company, Limited.—The annual return of the above-named company, made up to December 31st last, and filed on the 5th ult., shows that out of a capital of £50,000 in £5 shares, 8 shares have been taken up, but no calls have been made. Registered office, 2, St. Mary's Passage, Cambridge.

Halifax and Bermudas Cable Company, Limited.—The annual return of the above company, made up to October 14th last, was filed on the 1st ult. The company has a capital of £50,000, in £5 shares, and all of these have been taken up, the full amount called, and all calls paid. Registered office, 33, Old Broad Street, E.C.

Irish House-to-House Electricity Company, Limited.—The annual return of this company, made up to the last day of December, was filed on the 15th ult. The nominal capital is £100,000, divided into 19,900 ordinary and 100 founders' shares of £5 each. 527 ordinary shares have been taken up, and upon all of these 10s. has been called, resulting in the payment of £202, and leaving £61 10s. unpaid. Registered office, 15, St. Helen's Place, E.C.

Kensington Court Electric Lighting Company, Limited.—The annual return of this company, made up to the 31st ult., was filed on the 6th inst. The nominal capital of the company is £10,000 in £5 shares. All of these have been taken up, the full amount called and all calls paid. Registered office, 148, Brompton Road, S.W.

Keys' Electric Company, Limited. — The annual return of this company, made up to December 31st, 1891, was filed on the 16th ult. The company has a nominal capital of £15,600 divided into 3,000 ordinary shares of £5 each and 600 founders' shares of £1 each. All of these have been taken up, and upon 300 ordinary and the founders' shares the full amounts have been called, while upon the remaining 2,700 ordinary shares £3 15s. per share has been called, and all calls (£12,225) have been paid. Registered office, 122 and 124, Charing Cross Road, W.C.

Laing Electric Light and Power Company, Limited.—(Owners of the patents for the Laing system of electric lighting).—The annual return of this company, made up to February 15th last, was filed on February 17th. The nominal capital is £1,000,000, in £10 shares, of which 12,007 were at the time of making up the return, taken up. Of these 12,000 have been issued as fully paid, and upon the remaining 7 shares the full amount has been called, but no calls have been paid. Mr. William Laing, of Paris, is the holder of 6,852 shares. Registered office, 13 & 14, King Street, Cheapside, E.C.

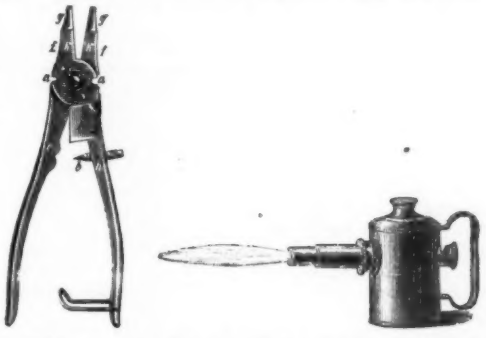
London Electric Supply Corporation, Limited.—The annual return of this company, made up to the 8th inst., was filed on the 20th inst. The nominal capital is £1,250,000, divided into 200,000 ordinary and 50,000 preference shares of £5 each. Of these 110,000 ordinary and 49,840 preference shares have been taken up, and upon each the full amount has been called. The calls paid (including £160 paid on 160 shares forfeited) amount to £798,630, and £5,730 is as yet in arrears. The Right Hon. Lord Wantage holds no less than 45,500 ordinary and 4,000 preference shares. Registered office, 3, Adelphi Terrace, W.

Nottingham Electric Light and Power Company, Limited.—The annual return of this company, made up to January 4th, was filed on March 4th. The nominal capital is £100,000, divided into 9,900 ordinary and 100 founders' shares of £10 each. At the time of making up, 27 founders' and 200 ordinary shares had been taken up, but as yet no calls have been made. Registered office, 22, Low Pavement, Nottingham.

Telephone Company of Egypt, Limited.—The annual return of this company, made up to the 19th inst., was filed on the 22nd inst. The nominal capital is £100,000, divided into 16,000 preferred shares and 4,000 deferred shares of £5 each. Of these, 12,071 preferred and 4,000 deferred shares have been taken up, of which 12,000 preferred and the deferred shares have been issued as fully paid. Upon the remaining 71 preferred shares the full amounts have been called, and all calls (£355) have been paid. Registered office, 14, Austin Friars, London, E.C.

BUSINESS NOTICES, &c.

Useful Tools.—Electrical engineers will be pleased with a new and handy instrument just placed on the English market by O. Berend & Co., 61, Fore Street, E.C. It practically combines several tools used in running wires for installation work, inasmuch as the wire is cut with the cutter, *a*, for ordinary installation, or, *d*, for lead covered cable; it is straightened by the edges, *k*, and bared of its covering by the wire stripper *b* and *c*; in using it for the latter purpose the point, *b*, is pressed gently into the insulation and the wire drawn along, a sufficiently deep incision being made to admit of the removal by means of *g* or *d*, of the covering material. The bare wire is cleaned by the outer edges *f*, and the loops formed by the rounded jaws *g*. The weight of the tool is about 12 oz., and its length 8½ inches. The



parts liable to wear, being screwed on, can be replaced, when necessary, at small cost. The same firm have lately brought out a new type of Barthel's patent automatic blow-pipe, soldering, and paint removing lamp, called the "Roarer." In the old form as shown in the illustration, an external tube is adjusted upon the blowpipe the intervening space serving as a wick chamber; in the new arrangement the wick chamber is a cylinder projecting from the container, the blow-pipe being arranged above and communicating with the wick chamber by a tube. From the small opening in the burner tube the vapour escapes. A slide for regulating the draught surrounds the blow-pipe.

The Electric Light in the West End.—Messrs. Smeeton and Page, of Queen Victoria Street, have carried out an installation of window electric lighting at the new premises, in the Strand, of Messrs. Loewenstark & Sons, jewellers and diamond merchants. Messrs. Mather and Platt, of Manchester, are engaged in fitting up an installation at Morley's well-known hotel in Trafalgar Square; Messrs. Verity and Sons, of King Street, Covent Garden, are fitting up an installation in the Covent Garden Hotel, Southampton Street, W.C. The Charing Cross Saloon in Buckingham Street, Strand, has also just been fitted with the electric light by Messrs. Vaughan and Brown of Kirby Street, E.C. This latter firm has also completed an installation at the Adelphi Wine and Spirit Stores in the Strand.

Tenders Wanted. — Bradford. — Tenders are being invited for the following works in connection with the extension of the electricity station in Bolton Road, viz., (1) supply and fixing of new roof, together with the alteration of the existing roof; (2) supply and delivery of ironwork, comprising cast iron columns and stanchions, wrought iron girders, and matters in connection therewith; (3) the construction and fixing of brick and concrete flooring. Plans an specifications can be seen at the office of Mr. W. T. McGowen, Town Clerk, Town Hall, Bradford, or of Mr. J. N. Shoolbred, C.E., 13, Victoria Street, Westminster, S.W. Tenders must be delivered to the Town Clerk by May 3rd.

Tenders Wanted.—Manchester.—The Gas Committee are inviting tenders for erection of buildings at their electric light station, Dickson Street. General conditions of contract and specifi-

cations can be obtained on application (in writing only) to Mr. C. Nickson, superintendent of the Gas Department, Town Hall. A deposit of £2 2s., which will be returned on receipt of a bonâ fide tender, must accompany each application for a tender form. Sealed tenders, addressed to the Chairman of the Gas Committee, and endorsed "Tender for Buildings," must be delivered at the Gas Offices, Town Hall, by 10 a.m. on May 2nd.

Tenders Wanted.—Chelmsford.—Tenders are invited by the Chelmsford Town Council for providing, laying, and maintaining a system of electric fire alarms and telephonic communication to and from various places in the borough. A map showing the positions of the fire alarms, &c., also a specification of the required works, may be seen at the office of Mr. G. H. Sasse, borough surveyor, 14, Museum Terrace, Chelmsford. Tenders to reach Mr. T. Dixon, town clerk, Chelmsford, by 12 noon on May 4th.

Tenders Wanted.—Kingston-upon-Hull.—The Municipal Corporation of Kingston-upon-Hull are inviting tenders for steam and other pipes, pumps, injectors, &c. Full information regarding drawings and specifications of the goods required will be found in our advertisement pages.

Tenders Wanted.—Dublin.—Tenders are being invited by the Corporation of the City of Dublin, for the supply of wires, fittings, and sundries, and the erection of the same for the electric lighting of some of the civic buildings. For further particulars see our advertisement.

Appleby Brothers.—Messrs. Appleby Brothers announce that further assistance being required to cope with the increase in their business, they have taken into partnership Mr. Percy Vavasseur Appleby, a Prizeman and an Assoc. Member of the Institution of Civil Engineers. A new edition of Appleby's Handbook of Machinery is in preparation and will shortly be published, which is intended to give full information, together with illustrations, prices, weights, &c., relating to all the firms' specialities.

The Royal South London Ophthalmic Hospital.—In this large pile of buildings now rapidly approaching completion, a system of telephonic and electrical communication from all parts of the building, even from the bedside of each patient to a small lobby where an attendant will always be on duty, has been carried out by Mr. Julius Sax of Ridgmount Street, Gower Street, W.C. The building is, in addition, lighted throughout electrically.

Sale.—Messrs. Wheatley Kirk, Price & Goulty have been instructed to sell by auction on Tuesday and Wednesday, May 17th and 18th, the valuable electrical machinery, plant and effects pertaining to the estate of Messrs. Nicholson & Jennings. A list of some of the machines for sale, and other information will be seen amongst our advertisements.

Change of Address.—Messrs. Browett, Lindley & Co., Limited, have removed to their new works which they have built at Patricroft, Manchester, where all communications should in future be addressed. Their telegraph address will be "Sandon, Patricroft," instead of "Sandon, Manchester."

Ship Lighting.—The Woodside Electric Company of Glasgow have fitted the electric light throughout the new steamer *Focas*, recently constructed by Messrs. J. Priestman & Co., of Sunderland.

Calendar.—Messrs. George Skudder & Co., cylinder and lubricating oil refiners of Tooley Street, S.E., have sent us one of their calendars for the current year.

CITY NOTES.

The Eastern Extension Australasia and China Telegraph Company, Limited.

The directors' report and accounts for the half-year ended December 31st, 1891, states that the gross receipts, including government subsidies, have amounted during the half-year to £243,658 8s. 10d., against £279,095 1s. for the corresponding period of 1890. In the latter figures, however, £8,031 was included for profit on exchange, whereas a loss of £3,232 has been experienced during the past half-year, in addition to which the receipts have been diminished by the reduction of rates to Australia, to which further reference is made below. The working and other expenses, including £22,091 17s. 6d. for cost of repairs to cables and expenses of ships, absorb £74,314 9s. 5d. against £74,090 3s. 2d. for the corresponding period of 1890, leaving a balance of £169,343 19s. 5d. From this is deducted £3,092 2s. 10d. for income tax, and £31,895 for interest on debentures, debenture stock, and contribution to sinking fund, leaving as the net profit for the half-year £134,356 16s. 7d. Against this £2,535 4s. has been charged for special expenditure as shown in the revenue account leaving a balance of £131,821 12s. 7d., which with £92,665 9s. 7d. brought forward shows an available balance of £224,487 2s. 2d. One quarterly interim dividend of 1½ per cent. has been paid for the half-year, and it is now proposed to distribute another of like amount, making, with the interim dividends paid for the first half-year, a total dividend of 5 per cent. It is also proposed to pay a bonus of 4s. per share or 2 per cent., making a total distribution of 7 per cent. for the year 1891. The balance of £111,987 2s. 2d. has been carried to the general reserve fund, which, after being credited with interest and debited with £191,163 2s. 4d. on account of the cable expenditure, now stands at £428,842 7s. 4d. In accordance with the provisions of the trust deed dated May 15th, 1879, 337 of the company's 5 per cent. Australian Government subsidy debentures, amounting to £33,700, were drawn by lot on the 4th instant for payment at par on July 1st next. The "guarantee" arrangement made with certain of the Australasian Governments for testing the effect of a 4s. rate to Australia has now been in operation for 11 months, with the result that the number of words transmitted has increased 48 per cent. over the corresponding period of 1890, and 60 per cent. over that of 1889, the year taken as the basis of the "guarantee," while the revenue has diminished at the rate of £55,000 per annum. By the terms of the agreement one-half of the loss is borne by the guaranteeing colonies, and the other half by the associated companies, and the Indo-European Department of Her Majesty's Indian Government according to their respective interests in the Australasian traffic. As the experiment, as far as it has gone, is considered not unsatisfactory, it has been decided to continue it for another year. Numerous interruptions have occurred on the company's system during the past half-year, but owing to most of the cables being duplicated, the traffic has not been materially affected except with Manila, which was unfortunately cut off from telegraphic communication for several weeks, the cable between Hong Kong and Cape Bolinao having broken at each end of the line during a severe typhoon. Negotiations have since been entered into with the Spanish Government for the duplication of the cable, and it is hoped that a satisfactory arrangement may be shortly brought about. All the cables are now in good working order. During the half-year under review the company's system has been extended to Sumatra in accordance with the arrangement concluded with the Netherlands Government, and referred to in the last report. The cable for this connection was taken from the company's stock at Singapore, and the cost of the operation (£14,924) has been debited to the reserve fund. A contract has also been entered into with the Netherlands-Indian Government for the manufacture and laying, on account of the Government, of a submarine cable to connect Acheen with the company's system at Sumatra, and an arrangement has been made with the Telegraph Construction and Maintenance Company for carrying out the work. The shareholders having at the last meeting approved the principle of establishing a staff pension fund, your directors are having the details worked out by experienced actuaries, and a scheme will be submitted to the meeting for dealing with the matter, together with a formal resolution empowering the directors to carry out the necessary arrangements. In accordance with the articles of association, John Denison Pender, Esq., and the Most Honourable the Marquis of Tweeddale, retire by rotation, and being eligible, offer themselves for re-election. The retiring auditors, Mr. Henry Dever and Messrs. Welton, Jones & Co., also offer themselves for re-election.

The Brazilian Submarine Telegraph Company, Limited.

The directors' report and accounts for the half-year ended December 31st, 1891, states that the revenue for this period amounted to £127,085 17s. 6d., and the working expenses to £32,486 2s. After providing £12,880 for debenture interest and sinking funds, and £1,037 7s. 4d. for income tax, there remains a balance of £80,682 8s. 2d.; to this is added £28,210 16s. 9d. brought forward from June 30th last, making a total of £108,893 4s. 11d. First and second interim dividends amounting to £39,000 have been paid, and £50,000 transferred to the reserve fund, leaving the sum of £19,893 4s. 11d. to be carried to the next account. The receipts for the half-year include the sum of £1,500 dividend to June 30th, 1891, on the company's shares in the African Direct Telegraph Company, Limited. In accordance with the provisions for repayment of the first issue of debentures, dated July 31st, 1884, 168 bonds representing £16,800 were drawn on the 11th instant, for payment at par on July 30th next. This, with the previous drawings, will make a total repayment of £113,600, leaving £36,400 of the first issue of debentures outstanding. The St. Vincent shore ends of the 1874 cables having become greatly worn by friction on the beach, they were renewed by the s.s. *Mirror* in October last. An interruption occurred on the 30th ult. in the 1874 cable of the St. Vincent-Pernambuco section near St. Vincent; arrangements were at once made for sending the s.s. *Mirror* from Gibraltar, and the repair was effected on the 9th instant. The duplex system of working has been satisfactorily established on the Lisbon-Madeira cable laid in 1882, and upon the Madeira-St. Vincent and St. Vincent-Pernambuco cables laid in 1884, thus very materially increasing the carrying capacity of the company's line. The various sections of the company's line are in good working order.

South American Cable Company, Limited.

This company has been formed with an authorised share capital of £500,000, divided into £50,000 shares of £10 each. The present issue is 30,000 shares of £10 each, of which 10,000 shares will be taken by the contractors, the India-Rubber, Gutta-Percha, and Telegraph Works Company, Limited, leaving £200,000, or 20,000 shares which are now offered for subscription. £300,000 of 5 per cent. mortgage debentures of £100 each, are also offered for subscription at £94 per cent. The board of directors consists of Sir Charles Tupper, Bart. (chairman); Hon. Henry Marsham; Sir Henry Mance; Mr. John Y. Buchanan, F.R.S.; Mr. Robert Kaye Gray, M.I.C.E. The company is formed for the purpose of completing an additional telegraphic route between Europe and South America. The cables are being laid between Pernambuco, in Brazil, and St. Louis, in Senegal, touching the island of Fernando de Noronha. At Senegal the cables will be connected to those of

the Spanish National Submarine Telegraph Company, which are laid between the Canary Islands and Cadiz, and the latter port being a submarine station of the Eastern Telegraph Company, communication with London and all parts of Europe will be easily accomplished. By calculations based upon the reports of the Brazilian Submarine Company for the last five years, the directors consider themselves justified in expecting that the gross revenue of not less than £85,000 a year will be secured by the South American Cable Company, which, after deducting £49,000 for working expenses, &c., would leave a sufficient balance to pay 10 per cent. on the present issue of share capital. We see no reason to doubt this result, and we think the 5 per cent. debentures at £94, redeemable as they are at par, a remarkably good investment for those who are indisposed to take ordinary commercial risks. It is expected that the whole of the cables will be completed by the middle of July. The subscription list closes on Tuesday next, 3rd prox.

Oriental Telephone Company, Limited.

THE ordinary general meeting of this company was held at Cannon Street Hotel on Wednesday, Mr. William Addison presiding.

In moving the adoption of the report and balance-sheet,

The CHAIRMAN said: I am glad to be able to again report the continued progress of the business of the company, although it is not as rapid as we could wish. The result of last year's working practically gives us a net income of about the same as the year before. The gross amount earned in rupees was in excess of the previous year, but owing to the low price of silver and consequent depreciation in exchange, our net profits have not materially increased. Had the same rates ruled during the past as in the previous year, we should then have made some £500 more. The question of exchange is necessarily a very serious one for an Eastern company, and as at present there seems little probability of any great advance in the value of silver, we must depend to a great extent upon increase of business to make up for the falling off in the value of the rupee. You will have seen from the report how we propose to deal with the amount of £11,169 13s. 7d., the result of the year's business, including £2,250 19s. 9d. brought forward from last year. The sum of £257 0s. 4d. was incurred in legal and other incidental expenses by proceedings in the High Court of Chancery for the purpose of testing the correctness of the view the directors took of the manner of declaration and distribution of the dividend. The decision of the Court was in favour of the directors' action. However, since the issue of the report the directors have received notice of appeal from the solicitor of the vendor shareholders against the decision of Mr. Justice Kekewich. The meeting will understand that I can make no remarks upon the case. The next item of £1,466 4s. 8d. in reduction of capital expenditure we consider necessary and proper. We propose to add £3,000 to the reserve fund, bringing that fund up to £10,000, all invested in consols, and consequently available at a moment's notice should any sudden emergency arise for its use. We do not think that any shareholder can object to such a sum being placed to reserve, as the whole of the reserve will not even then amount to 1s. per share on the uncalled capital of the company. It has been the endeavour of the board to accomplish two things, the one to arrange terms with the holders of the vendors' shares on a reasonable and equitable basis, and the other to abolish or greatly reduce the liability of 9s. on the ordinary shares, upon which 11s. are paid. Difficulties hitherto insurmountable have presented themselves to hinder our endeavours, but we are in hopes of arriving at a satisfactory settlement. In the meantime we consider it prudent to add yearly to the reserve fund, so that in the event of new business being undertaken we can enter upon it without having to make a call on the shareholders. I need add nothing to what is contained in the report in reference to the Indian companies. The Telephone Company of Egypt is still progressing, and pays its 6 per cent. on the preferred shares, the whole of which we practically hold. All the exchanges worked by your company are kept in a state of efficiency. In respect to the shares held in subsidiary companies by this company, your directors are of opinion that they are fully of the value assigned to them in the balance-sheet, viz., £91,937 14s. 10d. In accordance with the resolution which was carried at the last general meeting, that the company's memorandum of association be altered so as to embrace "any business or manufacture relating to the generation, employment, or utilisation of electricity or magnetism, or the apparatus connected therewith," application was made to the Court for permission, which was granted, provided the name of the company were altered, so as to show the enlarged powers of the company, and a resolution that the name of the company be changed to "Oriental Telephone and Electric Company, Limited," will be submitted to this meeting. The board wish it to be distinctly understood that although acquiring the new powers in view of the daily increasing uses to which electricity can be put, it is not their intention to rush into electrical business of a speculative or experimental character. In conclusion, I may mention that during the seven years the present board has been in office, besides placing £10,000 to reserve fund, £10,099 has been written off in various ways, and £2,750 invested in the purchase of debentures and shares in our subsidiary companies, whilst £15,050 has been paid in dividends, exclusive of that we are recommending you to declare to-day. This result I think you will consider very satisfactory. I beg now to move that the report and balance-sheet be adopted, and a dividend be declared.

This was unanimously carried.

A special resolution to the effect "That the name of the company be changed to 'The Oriental Telephone and Electric Company, Limited,'" was then adopted.

The retiring directors and auditors being re-elected, the meeting came to a close.

The Indo-European Telegraph Company, Limited.

THE twenty-fifth ordinary general meeting of this company was held on Wednesday last (27th inst.), at Winchester House, Old Broad Street, E.C., Mr. J. H. Tritton presiding.

The MANAGING-DIRECTOR (Mr. Andrews) read the notice convening the meeting, and the report having been taken as read,

The CHAIRMAN said: Now, gentlemen, I have to move that the report and accounts be received and adopted, and that the dividend mentioned therein be declared, and in doing so I am glad to find that there is very little to say, because, as we all know, prosperity does not call for much comment, and the year now past has been, on the whole, a favourable one for us. The receipts have increased by £2,891, and the number of words exchanged with India has, for the first time, exceeded by 40,390 the number of words exchanged before the reduction of the rates, which was applied in 1886, although as yet the money earned shows an amount of £39,521 less than it would have been had the rate not been reduced with similar traffic. The expenses are £57,901 on all accounts, and, as you have seen, we are able to place £10,000 to the reserve fund and to recommend the payment of a dividend which, with the interim dividend already paid, makes up 10 per cent. for the year. We carry forward £5,983, as against £4,168 last year. You will, perhaps, remember that at the last meeting I expressed to you my personal opinion that the 12 months' trial then proposed of the reduced rates with Australia was not sufficient. Well, gentlemen, that has so turned out; we have not yet got accounts for the whole year's traffic, and it has been determined by all the parties to the agreement not to give the required notice of termination, and consequently the agreement remains in force. As far as we can gather, the increase in the number of words sent is proving, on the whole, satisfactory. There is, of course, a falling off in the money receipts from messages under the reduced tariff, but that was to be expected, and the elasticity apparent in the business is so far promising. We have, of course, as you will have expected, sustained a loss of South Russian traffic, owing to the failure of the wheat trade from the Black Sea, and also owing, of course, to the famine which has been so grievously prevailing in parts of Russia. We have thought it well to contribute, on behalf of the company, towards the sufferers, in that famine in Russia, the sum of £500 as a company, which we have no doubt you will approve when it comes to be laid before you in the current year's account, as it will be in the ordinary course. With Persia there has been increased telegraphic intercourse, by which we have benefited, and, on the whole, taking the complete range of the business, there is, as already stated, an improvement in the company's affairs, which I imagine you will concur with me in finding satisfactory. The maintenance and working of the through lines of the Indian Government and of the company continue to be perfectly satisfactory. I do not know, gentlemen, that there is anything more that I need advert to; the best and most eloquent chairman's speech is contained in the resolution which I am about to submit to the meeting: "That the report and accounts now submitted be received and adopted, and that a dividend be, and is hereby declared, for the half-year ended December 31st, 1891, of 17s. 6d. per share, making, with the dividend already paid, 6 per cent. for the year, and a bonus of 20s. per share, both free of income tax, making in all 10 per cent. for the year.

The motion was seconded by Mr. H. WEAVER, and carried unanimously.

The CHAIRMAN then moved that Messrs. H. Weaver and L. Delbrück be re-elected directors of the company.

This was seconded by General G. B. TREMENHEERE, R.E., and carried.

It was next proposed by Mr. SMITH, seconded by Mr. STEPHENS and carried unanimously, that Messrs. Kemp, Ford & Co., be re-elected auditors of the company.

A vote of thanks to the chairman and directors having been acknowledged by the chairman, the proceedings terminated.

Madras Electric Tramway Company.—The above company has been formed with a nominal capital of £100,000, in shares of £1 each, for which subscriptions are now being invited. From the prospectus it appears that the undertaking has been formed for the purpose of acquiring a concession which was granted by the municipal authorities of Madras in 1891 for the working of tramways in Madras. The directors consider the enterprise will prove a sound business investment, yielding substantial profits. The motive power to be employed is electricity, conveyed by overhead wires from a central. Arrangements for commencing the construction of the lines are in so forward a state that the works will be speedily commenced. It is expected that, within 12 months, sections 1, 2 and 5 will be in full activity. The directors anticipate that not more than half the share capital will be called up. With a portion of the capital the sections mentioned will be constructed and the other sections continued with money raised on debentures at 5 per cent., thus enabling the share capital to earn a dividend to the maximum permitted by the concession order, namely, 15 per cent. The lists will close on May 4th.

West India and Panama Telegraph Company, Limited.—The directors of this company recommend dividends for the six months ended December 31st, 1891, of 6s. per share on the first and second preference, and 6d. per share on the ordinary shares, carrying forward £2,123.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending April 22nd, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brasilian Telegraph Company Limited, amounted to £2,516.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Amount Issued.	Name.	Stock or Share.	Closing Quotation, April 21st.	Closing Quotation, April 28th.	Business done during week ending April 28th, 1892. Highest.	Lowest.
250,000*l*	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	100 —103	100 — 103	...	...
1,300,980*l*	Anglo-American Telegraph, Limited	Stock	48½— 49½xd	48½— 49½	48½	...
2,849,510*l*	Do. do. 6 p. c. Preferred	Stock	87½— 88½xd	87½— 88½	88⅜	87⅞
2,849,510*l*	Do. do. Deferred	Stock	11 — 11½	11 — 11½	11⅛	11⅜
130,000	Brazilian Submarine Telegraph, Limited	10	10⅜— 11¼	10½— 11	11⅛	10½
53,200*l*	Do. do. 5 p. c. Bonds	100	100 —103	100 —103	...	...
75,000*l*	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	104 —108	104 —108	...	...
77,978	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	3 — 3¼	3 — 3¼	3⅛	...
69,996	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	2 — 2¼	2 — 2¼	2⅛	...
40,000	Chili Telephone, Limited, Nos. 1 to 40,000	5	3½— 4½	3½— 4½	...	...
50,000	City and South London Railway, Nos. 1 to 50,000	10	2½— 3½	2½— 3½	...	...
30,152	City of London Elec. Lighting Co., Ltd., Ord. 40,001-70,152, £4 paid	10	7½— 8	7½— 8	...	...
$7,716,000	Commercial Cable, Capital Stock	$100	155 —160	155 —160	...	...
224,850	Consolidated Telephone Construction and Maintenance, Limited ..	14/-	⅜— ½	⅜— ½	...	...
20,000	Crompton & Co., Ltd, 7 p. c. Cum. Pref. Shares, Nos. 1 to 20,000	5	5½— 5⅝	5½— 5⅝	5⅝	...
16,000	Cuba Telegraph, Limited	10	10½— 11½	10½— 11½	11 7/16	11¼
6,000	Do. do. 10 p. c. Preference	10	16½— 17½	16½— 17½	...	...
12,931	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	3¼— 3⅜	3¼— 3⅜	3¼	...
6,000	Do. do. 10 p. c. Preference	5	8½— 9½	8½— 9½	...	...
60,710	Direct United States Cable, Limited, 1877	20	11¼— 11½xd	11⅜— 11⅝	11⅝	11 5/16
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14⅝— 14½xd	14⅝— 14¾	14¾	14⅝
70,000	Do. 6 p. c. Preference	10	15 — 15½xd	15½— 15⅝	15½	15¼
200,000*l*	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	106 —109	106 —109	...	...
1,200,000*l*	Do. 4 p. c. Mortgage Debenture Stock	Stock	109 —112	107 —110xd	112	111
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	15 — 15¼	15¼— 15⅜	15¼	15 1/16
78,300*l*	{ Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326 }	100	102 —105	102 —105	...	...
276,200*l*	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	102 —105	102 —105	...	...
320,000*l*	Do. 4 p. c. Debenture Stock	Stock	108 —111	108 —111	109½	109
135,000*l*	{ Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343 }	100	102 —105	102 —105	102¼	...
180,400*l*	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	102 —105	102 —105	...	...
201,600*l*	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	99 —102	99 —102	...	...
45,000	Electric Construction, Limited, Nos. 101 to 45,100	10	5⅜— 6¼	5⅜— 6¼	6¼	5 7/16
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ...	... ...	...	...
66,750	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	1⅜— 1⅝	1½— 1⅝	1½	1⅜
70,000	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	2½— 2⅝	2½— 2⅝	2⅝	2 1/16
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd.	2	1½— 1⅝	1⅝— 1⅝	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	2 — 3	2 — 3	...	...
180,227	Globe Telegraph and Trust, Limited	10	10 — 10¼xd	10 — 10¼	10¼	10
180,042	Do. do. 6 p. c. Preference	10	15 — 15½xd	15⅛— 15⅜	15⅜	15
150,000	Great Northern Tel. Company of Copenhagen	10	18¾— 19½	19 — 19½	...	...
220,000*l*	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	105 —108	106 —109	...	...
12,134*l*	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ...	10	7¾— 8¼	7¾— 8¼	...	...
9,600*l*	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	9½— 10½	9½— 10½	...	...
41,600	India-Rubber, Gutta Percha and Telegraph Works, Limited ..	10	19½— 20½	20 — 21	20⅞	20⅛
200,000*l*	Do. do. 4½ p. c., Deb., 1896	100	102 —105	102 —105	...	...
17,000	Indo-European Telegraph, Limited	25	41 — 43	39 — 41	...	...
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	4½— 5½	4½— 5½	4⅛	...
11,334	Do. do. Preference Nos. 5,667 to 17,000 ...	10	8 — 9	8 — 9	...	...
30,000	†Liverpool Electric Supply, £3 paid	5	2⅞— 3	3⅛— 3½	3½	3¼
10,000	Do. do. fully paid	5	5 — 5⅛	5 — 5⅛	5 1/16	4¾
38,348	London Platino-Brazilian Telegraph, Limited	10	6 — 7	6 — 7	...	...
100,000*l*	Do. do. do. 6 p. c. Debentures	100	106 —109	106 —109	...	...
49,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	8¼— 8⅜	8¼— 8⅜	8 1/16	8¼
447,234	National Telephone, Limited, Nos. 1. to 438,984	5	4⅜— 4⅝	4⅜— 4⅝	4⅝	4⅜
15,000	Do. 6 p. c. Cum., 1st Preference	10	12½— 13½	13 — 13½	...	...
15,000	Do. 6. p. c. Cum. 2nd Preference	10	12 — 12½	12 — 12½	...	...
420,000*l*	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	106 —108	106 —108	107½	106¾
250,000*l*	Do. (issued at 5 p.m., all paid)	...	104 — 106	104 —106	...	...
6,318	Notting Hill Electric Lighting Company, Limited, £8 paid ...	10	4½— 5½	4½— 5½	4⅛	4⅛
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	¼— ⅜	¼— ⅜xd	...	...
9,000	Reuter's Limited	8	6 — 7	5½— 6½	5 1/16	...
18,680	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	8¼— 8⅜	8¼— 8⅜	8⅜	8 1/16
20,000	Do. do. 7 per cent. pref., Nos. 20,081 to 40,080	5	7½— 8	7½— 8	7⅞	7 9/16
3,381	Submarine Cables Trust	Cert.	115 —120	115 —120	...	...
78,949	Swan United Electric Light, Limited ... ... (£3½ only paid)	5	3⅜— 4½	3⅜— 4½	...	...
37,350	Telegraph Construction and Maintenance, Limited	12	42 — 44	42 — 44	43⅜	42⅜
150,000*l*	Do. do. do. 5 p. c. Bonds, red. 1894	100	101 —104	101 —104	...	...
58,000	United River Plate Telephone, Limited	5	2 — 3	2 — 3	...	...
146,370*l*	Do. do. 5 p. c. Debenture Stock ...	Stock	85 — 95	85 — 95	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	7 — 8	7 — 8	...	...
271,400*l*	Do. do. do. 5 p. c. Debentures	100	99 —102	99 —102	..	...
30,000	West Coast of America Telegraph, Limited	10	2½— 3½	2½— 3½	...	...
150,000*l*	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	102 —106	102 —106	105	...
67,007	Western and Brazilian Telegraph, Limited	15	10 — 10½	9½— 10	10⅜	9½
30,364	Do. do. do. 5 p. c. Cum. Preferred	7½	6 — 6½	6 — 6½	6⅜	...
30,364	Do. do. do. 5 p. c. Deferred	7½	4 — 4½	3⅜— 4½	...	...
189,700*l*	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	104 —107	105 —108	...	...
237,200*l*	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	104 —107	105 —108	106½	105½
88,321	West India and Panama Telegraph, Limited	10	1⅜— 1⅞	1⅜— 1⅞	...	...
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	10 — 10½	10 — 10½	10¼	10⅛
4,669	Do. do do. 6 p. c. 2nd Preference ...	10	9 — 10	9 — 10	...	...
80,000*l*	Do. do. 5 per cent debentures (1917) No. 1 to 1,000	100	99 —103	99 —103	...	...
$1,336,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	118 —122	118 —122	...	...
173,100*l*	Do. do. 6 p. c. Sterling Bonds	100	93 —102	98 —102	...	...
59,900	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	6½— 7	6½— 7	6⅞	6 1/16

* Subject to Founders' Shares. † Quotations on Liverpool Stock Exchange.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED:—Blackpool Electric Tramway Company, Limited, £10 (£6½ paid) 7⅛—7⅜.—Electric and General Investment, shares of £5 (£1 paid), 2—2½.—Founders' shares, 150—200.—Elmore Foreign and Colonial Copper, Founders' shares, 6¾—7½.—European Sims-Edison Torpedo Company, shares £20 (fully paid), 20—20½.—Founders' shares, 10—20.—Halifax and Bermuda Cable, 4½ per cent. bonds 80—90.—House to House Company (£5 paid) 2½—3½.—7 per cent. Preference Shares of £5 (fully paid) 5¼—5⅜.—Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid), 5¾—6, 1st Preference Cumulative 6 per cent., £5 (fully paid), 5⅞—6.—Liverpool Electric Supply Shares of £5 (fully paid), 5—5⅛.—London Electric Supply Corporation, Ordinary (£5 paid), ⅞—1⅛.—Do. 6 per cent. Preference, 1½—1¾.—Manchester, Edison and Swan Company, £9 (£1 paid), ⅛—⅜.—Metropolitan Electric Supply Company, Founders' Shares, 300—400.—Queen Anne's Mansions Lighting and Heating, Deferred shares of £10 (fully paid), 10—½.—Do. 4½ per cent. preference shares of £10 (fully paid), 10—¼.—Do. Debentures, 103—¼.—Woodhouse & Rawson Ordinary of £5 (£2 10s. paid), ⅛—¼.—£5 Preference (fully paid), 2½—3.—Ward's Electric Car (£10 paid), 1⅛—1⅜.

BANK RATE OF DISCOUNT.—2 per cent. (April 20th, 1892).

The Thomson-Houston Electric Company.

THE annual meeting of this company was held at Middletown, Conn., on Monday, April 11th. The old board of directors was re-elected, and the report of the company's finances and business for the year ending February 1st, 1892, was presented by Vice-President Coffin.

The following board of directors was elected:—H. A. Pevear, C. A. Coffin, J. I. Smith, B. S. Spinney, C. H. Newhall, S. A. Barton, E. Griffin, S. E. Peabody and T. J. Coolidge, all of Boston.

The report contains many interesting figures regarding the business of the past year. Owing to the extremely depressed and precarious condition of the commercial interests of the country at the opening of the year an essential decrease in the business of the company was experienced during the first few months of the year, particularly in the portion derived from the local lighting organisations operating from central stations. The business of the street railway department was seriously interfered with during the spring and the early summer by a radical change in the type of motors manufactured by the company. This loss, however, was wholly recovered during the second half of the year.

The unfilled orders in hand at the present time, as compared with the same date of the last year, are more than double in amount; and in each of the various departments of the business, the orders received since the first of January are very largely in excess of those of a year ago.

A recapitulation of the business from the Boston office of the company for the past nine years is as follows:—

1883	$426,987.97	1888	$4,435,902.23
1884	700,470.46	1889	8,222,789.12
1885	983,996.05	1890	10,217,661.67
1886	1,405,041.74	1891	10,304,580.17
1887	2,335,594.80		

As stated above, the activity in local company enterprises has been less than during the previous year. Notwithstanding this, the newly organised lighting companies established during the 12 months ending January 1st, 1892:

Aggregated in number	118
The total number reported January 1st, 1891, was ...	755
Total January, 1892	873

These companies have in use 100,293 arc lights and about 800,000 incandescent lights manufactured by the Thomson-Houston Electric Company, as compared with 87,131 arc lights and 616,355 incandescent lights January 1st, 1891.

The number of street railway companies operating and under contract, reported January 1st, 1891, was 145; added during the year, 59; total, January 1st, 1892, 204. Employing altogether nearly 3,000 cars, with an aggregate mileage of about 2,500 miles.

The balance-sheet, as presented by Benj. F. Peach, Jun., assistant treasurer of the company, is as follows:—

BALANCE SHEET, January 30th, 1892.

Assets.

Accounts receivable, Mdse.	$6,601,293.03	
Less deductions, 10 per cent. (*a*) ...	660,129.30	
		$5,941,163.73
Notes receivable...	1,636,800.35	
Less deductions, 7½ per cent. (*b*) ...	122,760.03	
		1,514,040. 3
Cash		1,727,276.16
Real estate, about 70 per cent. of cost		430,241.24
Machinery and tools about 60 per cent. of cost ...		491,044.53
Office furniture and fixtures (*c*)		
Cost $27,334.23 (charged off)		
Patterns and models		135,000.00
Patents (expense for the year charged off)		338,354.29
Local Company's stocks, 35 per cent. of par (*e*) ...		473,586.60
Local Company's bonds, 70 per cent. of par (*f*) ...		1,858,570.00
Manufacturing Company's stock, at cost (*g*)		3,729,195.50
Construction Company's stock at cost (*g*)		1,210,750.00
United Securities Company's stock at cost		525,420,00
Consignments		32,116.79
Merchandise inventory, factory (*h*)		1,731,481.55
" " railway supply department...		72,593.23
" " lighting supply department		52,613.63
		$20,263,447.57

Liabilities.

Capital stock—Common	$6,000,000.00
" " —Preferred	4,000,000.00
Accounts payable—Merchandise	429,808.24
Notes payable—Collateral	1,429,486.14
" " —Unsecured	587,005.23
Mortgage	1,200.00
Guarantee account (from accrued surplus)	200,000.00
Surplus, February 1st, 1891	6,022,533.71
Profits for the year $2,760,780.25	
Less dividend paid during the year 1,236,366.00	
	1,524,414.25
	$20,263,447.57

Statement of Surplus Account.

Surplus, February 1st, 1891	$6,022,533.71
Income for year ending January 30th, 1892, after deducting dividends paid during the year	1,524,414.25
Surplus, January 30th, 1892	$7,546,947.96

In explanation of the deductions made from the assets of the company, it may be stated that following the conservative policy that has always prevailed, allowances have been made with an idea of placing upon each and every asset a value which will be safe in any contingency.

(*a*) From accounts receivable the same deduction has been made as in former years. This has, in previous years, always been found ample.

(*b*) The deduction of seven and one-half per cent. from Notes Receivable is two and one-half per cent. in excess of the rate deducted in former years, and is regarded more than a sufficient guarantee for contingencies.

(*c*) Following the precedent of last year, the expense incurred for office furniture and fixtures during the year has been charged to expense account.

(*d*) While a large sum has been expended during the past year in the acquisition of patents, this has all been charged to current expense instead of adding to the patent account.

(*e*) In local company's stocks a deduction of 65 per cent. is made, which is 5 per cent. in excess of deductions in former years. More than $200,000 of stocks and bonds of railway and lighting companies at par value are carried in a separate account as of doubtful, though of considerable prospective value, and do not appear in the inventory at all.

(*f*) These bonds are nearly all payable in gold, and are amply secured by sinking funds and other protective provisions, made under the supervision of competent attorneys of our own selection. A large profit should be realised from the sale of these bonds.

(*g*) The Manufacturing and Construction Companies' stocks are taken at their cost value. The companies represented by these stocks are making very satisfactory earnings and working in harmony with the Thomson-Houston Company, thereby contributing largely to the success of this company.

(*h*) The inventory of merchandise and material at the factory has been taken in the usual way, *at less than actual cost.*

The following table shows the number and capacity of the companies using arc and incandescent lights of the Thomson-Houston system in the United States:

	No. of Companies.	No. of arc lamps.	No. of incandescent lamps.
January 1st, 1883	5	365	...
January 1st, 1884	31	2,478	...
January 1st, 1885	59	5,867	..
January 1st, 1886	100	13,227	...
January 1st, 1887	171	21,840	11,275
January 1st, 1888	303	36,936	59,330
January 1st, 1889	419	51,621	120,380
January 1st, 1890	587	68,203	281,555
January 1st, 1891	755	87,131	616,355
January 1st, 1892	873	100,293	806,500

The following table shows the number of railway companies using the Thomson-Houston system:

	No. of companies.	No. of cars.	Miles of track.
January 1st, 1890	92	701	420.29
January 1st, 1891	145	1,532	1,159.81
January 1st, 1892	204	2,769	2,363.63

The statement of profits and surplus account makes the following showing:

	Added to surplus from profits.	Total surplus.
January 1st, 1883	$17,237.85	.....
January 1st, 1884	93,696.74	$110,934.59
January 1st, 1885	96,187.10	207,111.69
January 1st, 1886	106,687.50	313,809.19
January 1st, 1887	123,006.05	426,815.23
February 1st, 1888	313,596.67	750,411.91
February 1st, 1889	660,828.82	1,411,240.73
February 1st, 1890	1,309,175.19	1,685,515.62
February 2nd, 1891...	4,337,117.79	6,022,533.71
February 1st, 1892	1,524,414.25	7,546,947.96

This addition to the surplus account for the year ending January 30th, 1892, amounting to $1,524,414.25, is the amount of profits, after paying 7 per cent. dividend on the preferred stock and quarterly dividends at the rate of 16 per cent. per annum on the common stock.

Elmore's French Patent Copper Depositing Company, Limited.

THE first annual ordinary general meeting of the shareholders of this company was held on Friday at Winchester House, Old Broad Street, Sir Richard J. Meade, K.C.S.I. (the chairman), presiding.

The SECRETARY (Mr. J. Shurmer) read the notice convening the meeting, and the report was taken as read.

The Chairman said: Gentlemen, I am sorry to say that I am compelled to ask your forbearance this morning, as, having a bad cold, my voice is so broken that I really cannot depend on speaking for five minutes together, so that I propose to ask the deputy chairman of the company, Major Jones, to read to you the remarks which I have drawn up for submission. I will only say that Major Jones is a gentleman who was for many years employed in one of the most responsible departments under Messrs. Armstrong, and that he has a special knowledge of manufacture of every description.

Major Charles Jones then read the chairman's speech as follows:—

Gentlemen, I have much pleasure in appearing before you to-day to give you the results of our stewardship up to the end of December last, and to congratulate you on the result and future prospects of the policy which was inaugurated by your directors, and approved by you, at the statutory general meeting, viz., that having satisfied ourselves as to the quality of the products made by the Elmore process, and the facility with which the same could be manufactured, we should follow no hesitating policy, but at once take the bold step of laying out our works on a scale commensurate with the importance of the industry. I am pleased to be able to state to you the success that this policy has attained. To-day we are in the unique position of having magnificent works already started—second to none in the world for the manufacture of this class of product—complete and capable of turning out 300 tons a month, whilst with comparatively little outlay and in a short space of time we should be able to nearly double this output. Had it not been for the broad policy so strongly urged by M. Secrétan, who would not accept the general managership of the company in France unless the works were commenced on what he calls a small, but what we call a large scale, viz., for an output of 300 tons a month, had it not been for M. Secrétan's assurance that he was abundantly satisfied that the quality, cost, and facility of manufacture of articles under the Elmore process would turn out what he is now able to prove, we should not at so early a stage have taken the responsibility—which, I may say, gentlemen, has until recently been a very great responsibility—viz., that of embarking your money in so large a factory, until we had actually been at work on a commercial scale. The responsibility we have undertaken is, however, amply compensated for by the satisfaction that we feel to-day in the successful carrying out of our policy. With regard to the accounts submitted with the directors' report, which is in your hands, these only deal with capital expenditure, and there is little to say in reference to them, as they explain themselves. Some of the items will not appear in future years, whilst, with regard to the administration charges, these have naturally been heavy, as they include all charges under this head in connection with the erection of the works, which will not occur again. The expenditure in the experimental workshop at Paris has been most usefully applied to the training of engineers and workmen in the Elmore process while the factory was being erected, so as to ensure their being fit for their duties on its completion, and also to the working out all special requirements of the French trade, which has enabled us to deliver the goods in demand directly we commenced manufacturing. With regard to the proposed increase of capital, your directors recommend that such increase shall consist of 100,000 shares of £2 each, of which 60,000 shall be now issued as preference shares entitled to 10 per cent. dividend, and a further 5 per cent. after the ordinary shares have received 15 per cent. The terms of this new issue will give to existing shareholders the right to subscribe for two-thirds of the amount. Shareholders who may wish for a larger allotment than they would be entitled to under the proportion this would allow them, viz., two shares for every five they now hold, can apply for a larger number. Some of our shareholders, whilst congratulating us upon our position, seem to have misunderstood our proposal. I may therefore state that it is true that no more than 60,000 preference shares should now be issued, and that no further capital should be issued until we have proved by the actual earnings of profits that the employment of this capital is advisable. You may be sure that your directors would not issue this capital unless its employment would increase the dividends that you were going to receive; and possibly, when we come to issue the capital we may be able to issue it on considerably better terms than those now offered. We have been criticised by some who say that the terms for the preference shareholders are far too good. All that we say to this is, that with the exception of a small amount of capital which we consider it advisable to issue to those outside the body of the shareholders, we shall allot to each shareholder his exact proportion, and, at the same time, those who would be desirous of having a larger allotment can apply, and their applications will be dealt with together with applications from the general public, and you may be sure that we shall well look after the interests of those shareholders who may so apply. M. Secrétan shows that the additional profit that would result from the employment of such further capital would be very large, and out of all proportion to the additional outlay. His estimate that you have received is based on actual experience, and it should be explained that it mostly represents the profits to be made on the cheapest articles of every-day consumption. It has been deemed advisable, in order to meet the demands of the market, to be able to supply every variety of article needed, and to turn our attention, in the first instance, to these cheaper productions. A large part of the new capital will be devoted to the production of the more valuable goods, from which larger profits will be obtained. I should add that the cost of production will be reduced, as the standing charges will not be materially increased, and the additions to the existing engine power will be comparatively small. I will not detain the meeting by further remarks, and will only add that we shall be happy to give any further information that may be required by any member present. I will now conclude by moving the following resolution: "That the directors' report and balance-sheet for the period commencing from the date of the company's formation, viz., September 10th, 1890, to December 31st, 1891, now submitted to the meeting be, and are, approved and adopted."

M. Eugene Secretan (general manager) next addressed the meeting in French, his remarks being afterwards translated into English by Mr. Kunst, the company's engineer. M. Secrétan said that he stood by the opinions he had given in his last report, which stated in the fullest way the actual situation and future earnings of the company. At the factory at Dives they were now producing in a perfectly industrial and commercial manner, and to increase the production all that was necessary was the capital which the shareholders were now asked to supply. M. Secrétan in his report had said that he would, from the beginning of April, ask for orders from the trade in France, but this had not been done, first, because there had been a small accident, which had delayed operations for five or six days, which had been now got over, and also because the company could get more orders than they could take without asking for them. People who had had the goods sent very satisfactory reports about them, saying they had never seen anything like them, and asking for goods much quicker than the company could deliver them. They were now producing about eight or nine tons a week, and in a short time the output would be materially increased. As to the criticisms which had been poured out, the facts the company were able to show at Dives would answer these at once fully and satisfactorily. The tubes which were exhibited in the room had only been asked for some three or four days previous to the meeting, and were made within 24 hours The tubes would stand the most trying test which could be put upon them, and would come out of the ordeal satisfactorily. There had been delay owing to certain changes which had to be made, because the use of copper in France was different to what it was in England. In France they were compelled to have all kinds of goods, from the smaller up to the biggest tubes, the French consumer making a contract with one house for all his requirements. M. Secrétan had worked very hard for the company during the last few months; for five weeks he had been at the factory 18 hours a day, and in one special emergency, to get over a difficulty, he had worked straight on end for two or three days and nights to see the thing through.

In reply to a question as to demand, M. Secretan read a telegram, which was explained by Major Jones, to the following effect: M. Secrétan had within the last week supplied samples, such as were exhibited in the room, to the largest industrial undertaking in France, and had received a telegram from them that, having tested the tubes in every possible way, they would enter into a contract with the company for all the copper they required for six months.

Major Jones seconded the resolution, and said the chairman was very good and laudatory in his opening remarks with reference to himself, and he might say that he had had considerable experience at the Armstrong works. He was there for ten years in a very responsible position, and during that time the works were doubled, and he had therefore had an opportunity of seeing a good deal of the work that was entailed in the erection of factories and shops, and in the starting of the machinery in them. The innumerable difficulties which had had to be encountered in the erection and starting of this company's works had caused some delay, but his own opinion was, not that that delay had been excessive, but that it was a great wonder that the factories had been started as they had been. It was only about 18 months since the prospectus was issued, and they were now in the position of having a complete factory at work, an increasing output, and of selling that output. This has been arrived at by the energy and devotedness of M. Secrétan, and he did not hesitate for one moment to endorse all that was said in the chairman's speech as regarded that. They heard a great deal about the eight hours day in England, but M. Secrétan had been working 18 hours a day, and, as they knew, had devoted his whole energy and resources to overcome all the causes of delay, and all the natural difficulties which were to be met with in starting large works of this sort, and he thought that great honour was due to him for what he had accomplished. The manufacture of tubes, such as were exhibited in the room, had been commenced, and he was glad to say that this was a class of work for which there was an enormous demand, and which could be sold straight away without their having to run about for orders. This class of articles did not pay quite so well as the exceptionally large goods which could be made, and would be made, by the Elmore process, and which would bring in a comparatively larger profit than that earned by the manufacture of smaller goods. The company could produce a far better quality of articles than could be produced by any other known process. The great feature of the Elmore process, after its cheapness, was the quality of the material and the uniformity of production. A large part of their factory was devoted to the manufacture of sheet copper and wire, and he would remind them that these were part of their patented articles, and that the company proposed to manufacture every description of article which was capable of being turned out by the Elmore process. They had not split the work up into branches, nor divided it into companies, but had kept it all to themselves, and it naturally followed that if they were to make the whole of these articles themselves, and supply the enormous demand which existed for them, this meant that they must work on a large scale. Before sitting down he wished to express to them his absolute personal confidence, as an expert in these manufacturing matters, in the Elmore process, and in M. Secrétan. He was convinced that they had an uncommonly good future for the company, and if the shareholders looked at it in the same light as that in which the directors looked at it, and sanctioned this increase of capital so as to enable the board to carry out the policy which they had inaugurated, he would be very much astonished and grievously disappointed if, when the directors met the shareholders in the course of another year, they were not able to congratulate them, not only on having a factory in existence and at work, but also in having established a process and the reputation of that process, on such a basis in France that there could be no more question or quibble about it; and, what was more, that they would be able to say something of a very pleasant nature on the subject of dividends.

Mr. SIMPSON, while expressing satisfaction at the facts and explanations which had been given by such great authorities, wished to know when the shareholders were likely to receive a dividend.

Mr. HOLLAND asked, amongst other questions, if the goods were now being turned out at a price which was satisfactory to the company, and stated that the shareholders would like to have the meetings held more frequently.

Mr. WILLIAM ELMORE, in reply to questions as to the output and earning capacity of the English Elmore and Wire Companies, said that for a considerable time after the commencement of the work they had to face difficulties of an almost unparalleled description, the whole of the plant having to be of original design. If shareholders could only visit the works at Leeds and see the quality of the products, the enormous number of orders pouring in, and the manner in which they were being executed, he did not think there would be much complaint. The whole plant of the Copper Depositing Company there was now at work, and this week they had delivered 18 tons. About two tons paid the working expenses. To put the matter shortly, in the parent company they were now working at the rate of something like a 40 per cent. dividend—outside the premiums which might be got from the granting of licenses, and so forth. The works of the Wire Company had now been satisfactorily started, although on a small scale as yet, and they would be able to turn out 150 tons weekly when quite completed. As to the operations at Dives, the samples in the room spoke most successfully as to what was being done in France. Such objects had never before been exhibited as the work of any process, and they spoke volumes in favour of the success of the enterprise.

Mr. SCOTT, as a consumer of Elmore copper, said that he used the material for a variety of purposes, in all of which it had answered admirably, and, in answer to a question, stated that he was steadily ordering and had orders being executed now.

Sir FRANCIS DE WINTON remarked that, as chairman of the American company, he had been in communication with some of the largest copper consumers in the United States. He read a letter to himself from one of the principal American copper brokers, who had visited the French works, the letter stating that the question had been satisfactorily answered as to whether the process was a success on a large scale, and speaking in the highest terms of the process, and saying that the writer had made tests upon the tubes actually being manufactured, which tests had turned out most satisfactorily.

The motion was then put, and carried unanimously.

The retiring directors, Messrs. E. J. Carson and William Elmore, were re-elected, as were the auditors, Messrs. Deloitte, Dever, Griffiths & Co.

The CHAIRMAN next proposed: "That the capital of the company be increased to £400,000 by the creation of 100,000 new shares of £2 each. Such new shares shall be called preference shares, and shall be entitled to priority on a distribution of assets, and shall also be entitled, out of the profits available for distribution in each year, to a preferential dividend of 10 per cent., and to a further dividend of 5 per cent., after a dividend of 15 per cent. has been paid on the existing shares of the company, which shall in future be called ordinary shares."

Major JONES seconded the motion, which was carried unanimously.

A slight amendment was suggested by Mr. HOLLAND to insert after the words £2, "on such terms as the directors may determine," and instead of "10 per cent." the words "not exceeding 10 per cent." It was understood that this should be accepted if there was no legal objection.

The meeting closed with the usual votes of thanks.

Elmore's French Patent Copper Depositing Company.—Acting on the resolution passed at the meeting held on Friday last, the directors of this company have announced the issue of 60,000 preference shares of £2 each, on which interest at 10 per cent. per annum is guaranteed for the first year from the date of payment of instalments by Elmore's Foreign and Colonial Patent Copper Depositing Company, Limited. There are reserved for allotment to the existing shareholders in the company 40,000 shares, and the remaining 20,000 are now offered for subscription. The company was formed in September, 1890, with a capital of £400,000, for the purpose of applying the system of copper deposition, invented and patented by the Messrs. Elmore, to the manufacture of copper articles direct from the rough copper plates. The preference shares are entitled to 5 per cent. additional (making 15 per cent. in all) out of the surplus available for dividend after the ordinary shares have received 15 per cent.

Johannesburg Lighting Company, Limited.—Subscriptions are invited to an issue by the Johannesburg Lighting Company (share capital £150,000) of 7 per cent. mortgage debentures in bonds of £50 each, being part of an authorised issue of £60,000, and at the option of the holders convertible into ordinary shares. The prospectus states that the company has acquired two concessions of the Government of the South African Republic for supplying gas and electric power for public and private lighting, heating, and other purposes, in the town of Johannesburg, the electric concession extending to the suburbs also. The demands for electric lighting are in excess of what the company at present can supply. It is estimated that the net revenue from gas and electricity will amount to £20,000 per annum, while the interest on the entire authorised issue of debentures is £4,200, leaving a large surplus for dividends on the share capital. Applications should be sent not later than Saturday, April 30th.

THE ELECTRIC LIGHT AT PORTSMOUTH.

OFFICIAL INQUIRY.

LAST week, at the Town Hall, Portsmouth, Mr. Arnold Taylor, Local Government Board Inspector, held an enquiry consequent upon the application of the Town Council for power to borrow £60,000 for carrying out an electric lighting scheme, under the provisions of an order obtained from the Board of Trade in 1890, and confirmed by the Electric Lighting Orders Confirmation Act, No. 5, 1890. The town clerk stated that the resolution adopting Mr. Shoolbred's scheme had been forwarded to the Local Government Board in due course, as also the subsequent resolution revoking that scheme, and adopting Prof. Garnett's.

Prof. GARNETT, in the course of an explanatory statement, pointed out that Portsmouth was in a somewhat unique position, on account of the extent of the area which came under the provisions of the Act, for in any case they were obliged to lay mains at least a mile from the central station to cover the area they were compelled to light efficiently. It was also possible for any number of ratepayers to ask that the light might be extended to any part of the borough, and even in the absence of a provisional order the council would be bound to treat all ratepayers alike in all districts. Therefore, practically, the boundaries of the borough were the boundaries of supply, and it was necessary to recommend some system that would admit of the rapid extension. The continuous current system, with low tension mains, similar to that adopted at Manchester, would be very expensive, and another scheme in which the lighting was done by accumulators would also be unsuitable. Lastly, there was a system of low tension mains with high tension feeders, and it seemed preferable to rely on some system that had been well tried. The cheapest system, so far as capital outlay was concerned, though most expensive in working, was that of high tension mains, and the placing of transformers in consumers' premises, as had been adopted in London. The alternative was to have a set of transformers at certain centres. The system he proposed to adopt combined the advantages of both these systems. It gave a complete system of secondary mains throughout the whole districts where primary mains were carried, and which could be fed from the high tension mains. They carried from their central station (the site of the Amphitheatre, destroyed by fire on Christmas morning, 1890) a number of circuits, and side by side with the high tension mains they carried a low tension main which would never be wanted to carry more than 140 ampères, which was the maximum current they expected it to carry. These would be fed from transformers placed beneath the pavements in street boxes. Wherever there was a large customer who wished to use, say, 200 lights, a street box transformer, capable of supplying 500 lamps, would be placed opposite his premises. They would therefore avoid the necessity of carrying a great deal of the current over a great length of the secondary mains. They would not be obliged to put in transformers until consumers made a demand, and while ultimately they proposed that they should be placed at distances of 300 yards, they might at first be 600, or even 900 yards apart, the number to be increased as the demand arose. The high tension current would never enter the consumer's premises, so that great economy in power was ensured, especially during the hours of lighting, and the loss which they might reasonably incur would be less than one-third that at Newcastle and in other towns where the transformers were placed in the consumers' premises. New consumers could be connected with the current without interference with the supply to other parts of the same district, and in the event of a transformer breaking down, the light would not be interrupted, but the district would be supplied from the adjacent transformers with but very little reduction of pressure. The mains would be able to carry 40 per cent. more current than they proposed to provide in the central station at present, so that they would be able, when the occasion arose, to increase their income by 40 per cent without additional outlay. The high tension current would be conveyed at a so-called pressure of 2,000 volts, but in alternating currents. They would be able to unload coals from the ships close to the central station at a great station, and they would also be able to obtain salt water for condensing at a small cost for pipes. His estimate of the total cost was £55,300, including £3,000 for site; but it was advisable to borrow £60,000, so as to cover the purchase of meters, the making of consumers' connections, and general capital.

It having been stated by a member of the Council that the scheme was only adopted by the casting vote of the Mayor,

His Worship (Alderman T. SCOTT FOSTER) explained that his casting vote was not given as between high and low tension, but in favour of the matter being dealt with at once, and not postponed. He was one of the deputation who went to Bradford, and was delighted with what he saw there; but they learnt subsequently that though the low tension system worked well in a town like Bradford, it would not do so in a place like Portsmouth, which was practically four towns.

Prof. GARNETT, answering a remark made by a ratepayer, said this scheme was only brought forward in the belief that it would provide for the repayment of the capital, with interest, as well as furnish some profit. If that was doubled there would be no difficulty, in the course of a few months, in getting the whole of the necessary capital subscribed for this undertaking. As to turbo-electric generators, such as were proposed, they had stood the test admirably within his experience, including a term of six months while the Newcastle Exhibition was in progress. He was in charge of the electric lighting of the exhibition, which was a larger undertaking than the scheme now proposed for Portsmouth. His scheme had been published in the electrical papers, and had been read probably by every electrical engineer in the kingdom; but he had not yet seen any adverse criticism of it.

Electric lighting at 6d. per unit was making headway each year in Newcastle, as against gas at 1s. 9½d. per thousand.

Mr. Manville, who is associated with Prof. Garnett as consulting engineer for the scheme, endorsed his colleague's statement.

Alderman Ellis, chairman of the Electric Lighting Committee, stated that when a private company was started in Portsmouth, applications were received for 16,000 16-candle-power lamps, which was double what the committee fixed their estimate at.

A Ratepayer having expressed a wish that the scheme had embraced the whole town,

Prof. Garnett said it could be extended at a cost of £2,500 per mile.

The enquiry was then brought to a close.

THE SUBMARINE CABLE FOR THE AZORES.

Translated from the "Commercio de Portugal" of April 16th, 1892.

An incident, which astonished the public certainly more than was foreseen by the Government, hinders the execution of the contract entered into by Senor Depechez, last parliamentary session, for the laying of a submarine cable between Lisbon and the Azores, France and England.

Through circumstances which are already understood, the "Camara," instead of ratifying this contract, have voted an authorisation to the Government to nullify it, in a manner most convenient to the interests of the country. From this it appears certain that this negotiation was shelved, and the Government ceased to realise how much the Azorians clamoured for this boon, as also that they were backed up by the continentals.

We do not understand the reason of the rumour, and still less the foundation for it, because from the moment the authorisation was granted, the fact of the first, or even the last attempt to realise an old and most justifiable demand, ought, instead of discouraging our illustrious minister of public works in the carrying out of his noble pledge to execute one of the boldest schemes of our times, to stimulate him to further patriotic diligence, and to cause him to bring himself in line with the honourable vote which was passed by the two Houses of Parliament. Moreover, we marvel at the rumour to which we have referred, when it is certain that his Excellency had more than one proposal submitted for his examination and approval, and amongst them one which had priority over all the others, and which was signed by such honoured and reputable names as Senor Duparchy and Senor Deffez in 1886 and 1887, such names being the best guarantees for its prompt and immediate execution; certain it is, too, that this is exempt from the objections and impediments which mar the English contract.

One fact we know in connection with this proposal satisfies our persistent demand, and this will, we have the pleasure to know, be brought before the special commission, and later on be the subject of discussion when the Chamber of Deputies proceeds to consider the above-mentioned contract.

We allude to what we have urged, and do not cease from urging that the *personnel* at the projected cable stations should be composed exclusively of Portuguese, nominated by our Government, or, at least, approved by them.

To our mind, this point is of capital importance, as we have had occasion to assert, and from this fact we derive our sympathy with the French proposal already referred to, as we are assured that this condition is unhesitatingly accepted by the proposers, who have no idea of usurping the power of the Government, vested in it by reason of its own dignity, so that should other considerations and interests not set it aside most unequivocally, we would ask that this may be considered without loss of time.

We do not wish to aggravate the delicate position in which the deputies and the Azorian people are placed just now in connection with what has happened to the latest contract for a submarine cable to the Azores, but the disagreeable effect which the announcement of the rejection of the Depeches contract has produced should not discourage their praiseworthy efforts, so that the Azores may not remain indefinitely cut off from the mother country and the rest of the world, although they are a part of the monarchy of which it can well be said that so badly are they held in esteem, that an advantage is denied to them which has already been allowed to, and is enjoyed by, the blacks of the two African coasts, as also to our Asiatic brethren. Still more is reparation justifiable and the grievance well-founded, seeing that the two African cables represent a very onerous burden on the country, including the Azores themselves, whilst the proposed cable between the mainland would cost the State nothing.

If, after the agitation which there has been in the Azores on the subject of alcohol, and the constant claims arriving by every packet, the Government still imagines it can provoke them without result by postponing the laying of this cable indefinitely, allow us to point out that it is not prudent to neglect this weighty question, and that they are unexpectedly deceiving themselves in their blind confidence in the patience and magnanimity of these people; both are, forsooth, great, and appear to be almost inexhaustible, but experience shows that everything has a limit, even the resignation of the weak to the superior power of the strong.

In the interests of the country and its Government, we trust that our illustrious Minister of Public Works, who has an upright and high character, will not put this subject on one side, and that he will not forget that those who, though far away, still follow the question eagerly and impatiently may rapidly become faint hearted and indignant.

THE ENERGY CONSUMED IN ARC LAMPS UNDER VARIOUS CONDITIONS.*

By Frank B. Widmayer.

In regard to the discussions in the *Electrical Engineer* on "Economy in Arc Light Wiring," and referring especially to Mr. Rommel's article in the issue of March 30th, I give below the results of some experiments I made on two well-known arc single carbon rack lamps, one a 10-ampère 2,000 C.P. lamp and the other a 4-ampère 800 C.P. lamp. The readings for voltage were taken across the binding posts and the average of a number of readings taken is given. The current readings were taken in the usual way by ammeter; the instruments used were the well-known Weston ammeter and voltmeter.

The object of these experiments was to determine three things, namely:—

First, energy in watts required to run the lamp under normal conditions.

Second, energy in watts consumed or wasted in lamp after carbons were consumed and dropped together and so cut out or burnt out, the current going through lamp, coils, and carbon stumps.

Third, energy in watts consumed in lamp after being cut out by the ordinary automatic cut-out, consisting of two small magnets in circuit, one of very fine wire in shunt and one of coarse wire in the main circuit; when the lamp is cut out, all the current flows through the small coarse wire magnet and armature which short-circuits the lamp between the two binding posts, with no current in the carbons, main line spools or shunts.

The following were obtained on the 10-ampère lamp.

Experiment No. 1.—10-Ampere Lamp.

First Case.—Burning 48 volts and 10 ampères. 480 watts consumed.

Second Case.—Loss in watts, or drop of potential in lamp with carbons together, current going through carbon stumps, spools, &c. Drop of E.M.F., 4 volts; current 10 ampères, thus, 40 watts consumed or lost in heating carbons, spools, &c.

Third Case.—Energy lost in watts through heating of cut-out coil. Drop, 2 (volts) × 10 ampères = 20 watts.

Experiment No. 2.—4-Ampere Lamp.

First Case.—E.M.F., 52 volts; current, 4 ampères. $52 \times 4 = 208$ watts consumed in running lamp.

Second Case.—E.M.F., 4 volts; current, 4 ampères. $4 \times 4 = 16$ watts lost in heating carbon stumps, spools, &c.

Third Case.—E.M.F., 1 volt; current = 4 ampères. $1 \times 4 = 4$ watts lost in cut-out.

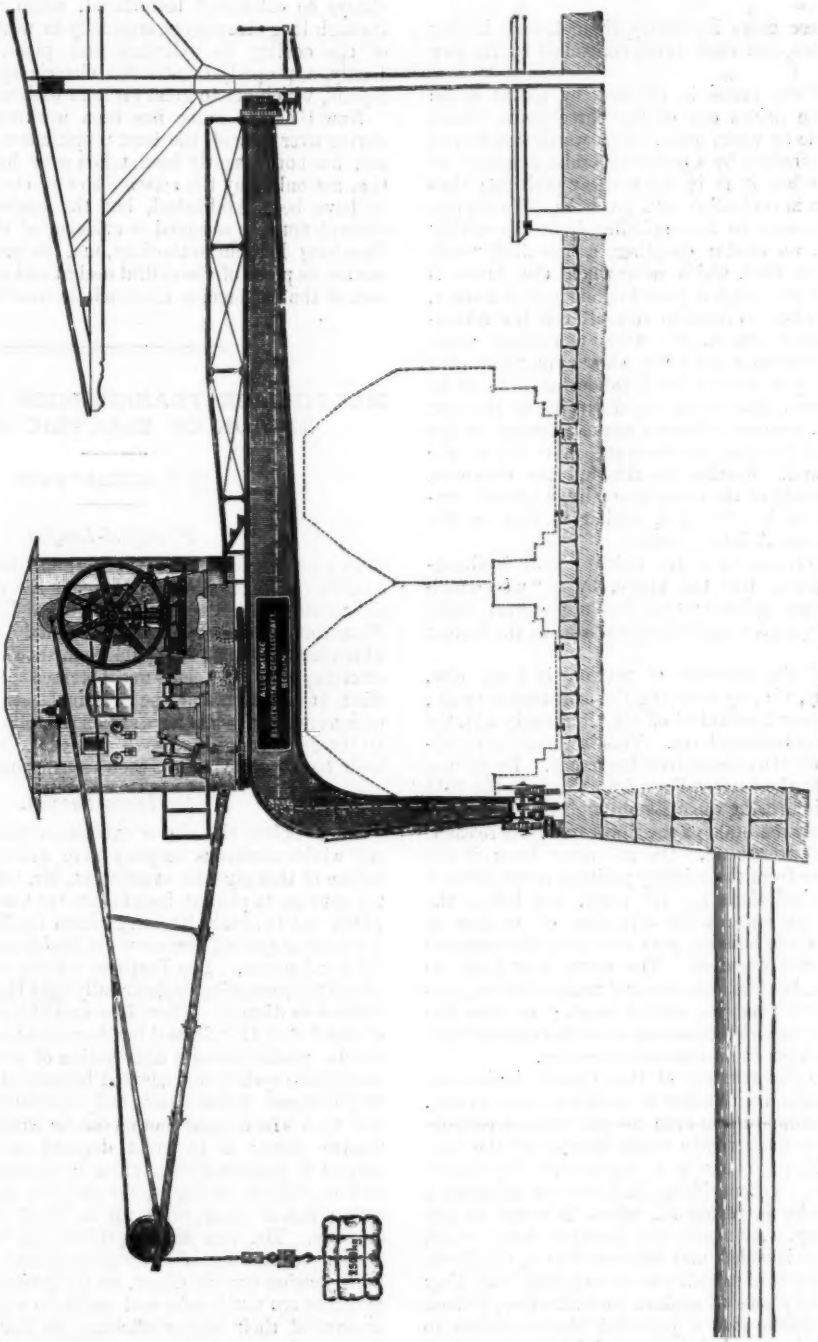
I think the most economical method of wiring arc lamps, especially in large cities where subway rentals are very high, is to run both the commercial and city lights on the same circuit and by having a good lamp, that is, one having the ordinary cut-out and a special cut-out, such as is described below—there would be no trouble with the service. Let us assume that the city lamps are all-night lamps and the commercial are 7-hour lamps. Start both at the same time, trim the commercial lamps so that they will run the time required and will drop out, that is, the carbons will drop together and close the circuit through the lamp. Have a small pin fixed on the carbon rod in the lamp case; this pin when the rod drops, say $\frac{1}{4}$ to $\frac{3}{8}$ inch, will trip a lever which will short-circuit the lamp across the terminals and so directly cut the lamp out of circuit.

If this method were used, I believe there would be a saving of from 30 to 40 watts on each 10-ampère lamp so equipped. Another method, but not as good as the one just described, would be to have the pin move the ordinary cut-out lever till it makes contact with the magnet and coarse wire coil; in this case the current would only flow through the coarse magnet in cut-out and so short-circuit the lamp in the usual way.

* *Electrical Engineer*, New York.

ELECTRIC TRAVELLING CRANE.

To the already numerous employments of electrical transmission of power, another has lately been added by the Allgemeine Elektricitats Gesellschaft of Berlin (London house, Keys' Electric Company, Limited), through the construction of an electrically driven dock crane for the harbour quays at Hamburg. This may be looked upon as a further step toward the development of a new field of great importance to the extension of the transmission of electrical power.



Electric Travelling Crane.

This travelling crane capable of carrying about 2¼ tons for loading and discharging large ships, was put in operation in November last, and it points to a significant prospect of the general adoption of electrical power to hoisting machinery, by reason of its having continued to work without interruption ever since, in spite of the unpropitious wintry weather.

The crane, as shown in the illustration, is constructed upon the now universally acknowledged principle of the traversing crane; and stands upon a traversing framework, which is high and wide enough to permit the passage under it of two lines of railway or waggon traffic, and it terminates alongside a goods shed, so as to pass the goods into and out of the latter.

The dimensions and points of its construction are as follows:—

Safe load, 2,500 kilogrammes (nearly 50 cwt.).

Total height of lift, 13·75 m. (say 45 feet).

Projection of the jib, *i.e.*, distance from the centre of the crane to the centre of the sling hook, 10·75 m. (35 feet 3 inches).

Vertical speed 1 m. per second. (197 feet per minute.)

Traversing speed 2 m. per second. (394 feet per minute.)

In the construction of the crane it was advisable that wire rope instead of chain should be used, and in the winding gear spur or bevel wheels had to be avoided for the sake of silent running. The handling of the crane was to be as far

as possible like that of hydraulic or steam power cranes, in which it is possible to raise or lower the load during the traversing of the crane.

The current is brought from the generating station through copper rods carried along the outside of the shed. This station also provides the light for the harbour, and was erected some time time ago by the Allgemeine Elektricitäts Gesellschaft; cables pass through the hollow pivot of the crane and lead to the controlling gear.

Around this pivot, which is seated in a turn table, revolves the whole winding and traversing mechanism of the crane, protected by a cabin with windows and mounted upon an iron platform.

Each set of these gears is entirely distinct, each having its own electro-motor, and each being controlled by its own particular lever.

The turning of the crane is effected by means of an electro-motor which drives one of the three guide wheels under the turn table by worm gear. The worm spindle can be stopped at any moment by a powerful brake actuated by the steering lever when it is in its midway position; thus the turning motion is controlled with precision. To obviate all liability to damage to the spindles from the swiftly rotating armature, an elastic coupling, a so-called "wire brush coupling" is used, which acts when the brake is applied, permitting the coupled parts to glide past each other, and allows the armature to come to rest after a few revolutions. For a similar reason, the above-mentioned guide wheel running on a smooth path was chosen in place of a toothed rail and spur wheel; for breakdowns were to be feared with the latter, through the rapid turning of the long derrick. There is, however, always a means afforded to the driver of modifying the speed of the crane, inasmuch as the motor is series wound. Further, for this and the backward and forward traversing of the crane generally, a special controlling arrangement is now used, similar to that on the tramway motor on the A.E.G. system.

The 40 H.P. electro-motor of the hoisting gear is shunt-wound and connected, like the above, by a "wire brush coupling" to a worm spindle which has a powerful brake actuated by the respective controlling lever, as in the former case.

The reversal of the direction of motion is here, also, attained electrically, viz., by reversing the armature current; the starting resistance is switched off simultaneously with the movement of the controlling lever. This in its midway position entirely cuts off the current from the motor. By pulling the lever backwards the current flows first through the field magnets, then in increasing quantity through the armature, while simultaneously the brake of the worm spindle is released and the load begins to ascend. On the other hand, if the lever is pushed over from the midway position in the forward direction, the manipulations are the same, but before the armature receives its current the direction of motion is changed, and the whole hoisting gear now runs the opposite way, so that the load descends. The worm now tends to drive the armature, but the shunt-wound motor does not permit it to force it beyond its normal speed; so then the armature acts as an electric brake, and sends the current back into the conductor instead of consuming energy.

Excellent as are the services of this electric brake, and although, in comparison with other methods (water or steam), it shows a great saving—up to even 20 per cent., according to circumstances—a dangerously rapid descent of the load might take place in the event of a rupture of the circuit through this brake. To provide against such an accident, a second electric brake is furnished, which is equal to any possible contingency. Alongside the hoisting drum, round which the wire rope is coiled, and connected to it, is a brake wheel, the brake blocks of which are so weighted, that they would be permanently pressed against the brake disc, if there were not on the opposite side a powerful electro-magnet to hold them back, so long as it is influenced by the passage of the main current. Any interruption of the main current makes this electro-magnet inoperative, permits thereby the brake blocks to fall against the disc, and instantly grips the whole hoisting gear, thus preventing further motion.

The advantages of this electric crane, compared with steam cranes, are very considerable. Firstly, the commercial efficiency of electric motors is, on the whole, higher than that of the steam motors of equal power hitherto employed on the Hamburg quays: with all other motors the efficiency falls off continuously from various causes, viz., the difficulty of keeping pipe joints, &c., tight. Then, the current used by the electric motors remains always very nearly proportional to the demand of the moment, whereas similar economy is impossible with the direct action steam cranes hitherto in use, because the principle of expansion is not brought to bear in these. Furthermore a saving (amounting sometimes, as before stated, to nearly 20 per cent.) is effected through the return current when the load is taken off the crane, which is not obtainable in the case of steam power. Again, with an electric system having proper insulation, the degree of efficiency may always be calculated beforehand, while considerable losses through long steampipes, especially in winter, in consequence of the cooling in cylinders and pipes, are unavoidable. Lastly, a properly constructed electric system requires few repairs, which are so great an item with all steam cranes.

Now that the crane has been working without a hitch during over four of the least propitious months of the year, and has consequently been taken over by the dock authorities, not only may the *raison d'être* of electric cranes be said to have been established, but the realisation of this first attempt must be accepted as evidence of the foresight of the Hamburg harbour authorities, and its prompt and complete success as proof of the skilful design and construction on the part of the Allgemeine Elektricitäts Gesellschaft.

MULTIPHASE TRANSMISSION AND DISTRIBUTION OF ELECTRIC ENERGY.

By A. RECKENZAUN.

Frankfort-Lauffen.

In a letter dated April 19th, 1892, the *Allgemeine Elektricitäts Gesellschaft*, of Berlin, sends the results obtained by the testing committee of the Frankfort Exhibition with the Frankfort-Lauffen transmission plant. The official report, which has not yet been published, shows that a maximum efficiency of 75 per cent. was obtained between the turbine shaft at Lauffen and the terminals at Frankfort, and the various measurements have shown the following losses, viz.:—In the generating dynamo 8 per cent., in the transmission leads 10 per cent., and in each transformer 3 per cent.

Heilbronn-Lauffen.

Long before the above exhibition plant was completed, and whilst numerous sceptics were discussing the probable failure of this gigantic experiment, Mr. Oscar von Miller had the courage to plan an installation for the city of Heilbronn, which was to obtain its energy from Lauffen by means of the three-phase system, and serve the double purpose of supplying light and power. The Portland cement works of Lauffen obtained the concession to electrically light Heilbronn, which is 12 kilometres distant. There is an available power of 1,500 H.P., of which 600 H.P. is used for the cement works, and 900 H.P. for the production and distribution of electric energy. The multiphase system was adopted because of its adaptability to long distance transmission, and especially on account of the ease with which small motors can be worked, and current for motive power is in great demand at Heilbronn. The current is generated at Lauffen by means of three dynamos, each capable of giving 4,000 ampères at a pressure of 50 volts; this is transformed up to 5,000 volts and about 38 ampères. Mr. von Miller prefers this "step-up" transformation to the use of alternators which would produce the high tension current direct, on the grounds that low tension dynamos are much safer and easier to maintain, and also on account of their higher efficiency, so that the loss, which in the transformer need not exceed 3 or 4 per cent., is fully compensated by these advantages.

The 5,000-volt current is transmitted through three bare copper wires, 6 millimetres thick, which are carried upon poles to the outskirts of the city of Heilbronn. Oil insulators are used, and these are fixed to crossbars upon wooden poles, varying in height from 8 to 14 metres. Some distance above the transmission wires there is a "barbed" steel wire running throughout the whole distance, and this serves as an

excellent lightning conductor by being earthed at numerous places.

Fig. 1 represents in diagrammatic form the arrangement of the circuits, machines, and lamps. Generator A and transformer T_1, are both at Lauffen. Transformer T_2 is at the outskirts of Heilbronn, and converts the 5,000 volts of the overhead line into 1,500 volts, to be carried into the city through underground mains. Mr. von Miller would not trust any system of underground mains to stand 5,000 volts with absolute safety, and as the energy had still to be carried to considerable distances, and economy in the sizes of conductors was important, he arranged for a second transformation. The current is thus conveyed by concentric cables to the transformers, 1, 2, 3 and 4, and thence distributed to the houses at a tension of 100 volts. Any desired number of these secondary transformers can be set up at convenient points; at present they are about 200 metres distant from each other. Notwithstanding the several transformations, there is an estimated loss of only 20 per cent., so that out of the 200 kilowatts produced at Lauffen by each dynamo, 160 kilowatts are delivered at Heilbronn, and used in arc lamps, incandescent lamps and motors. The entire installation, including water power, has cost £18,750 up to the present, with 4,200 installed 16 C.P. lamps, or something less than £4 10s. per lamp. The electrical plant was the joint production of the Oerlikon Works and the Allgemeine Electricitäts Gesellschaft.

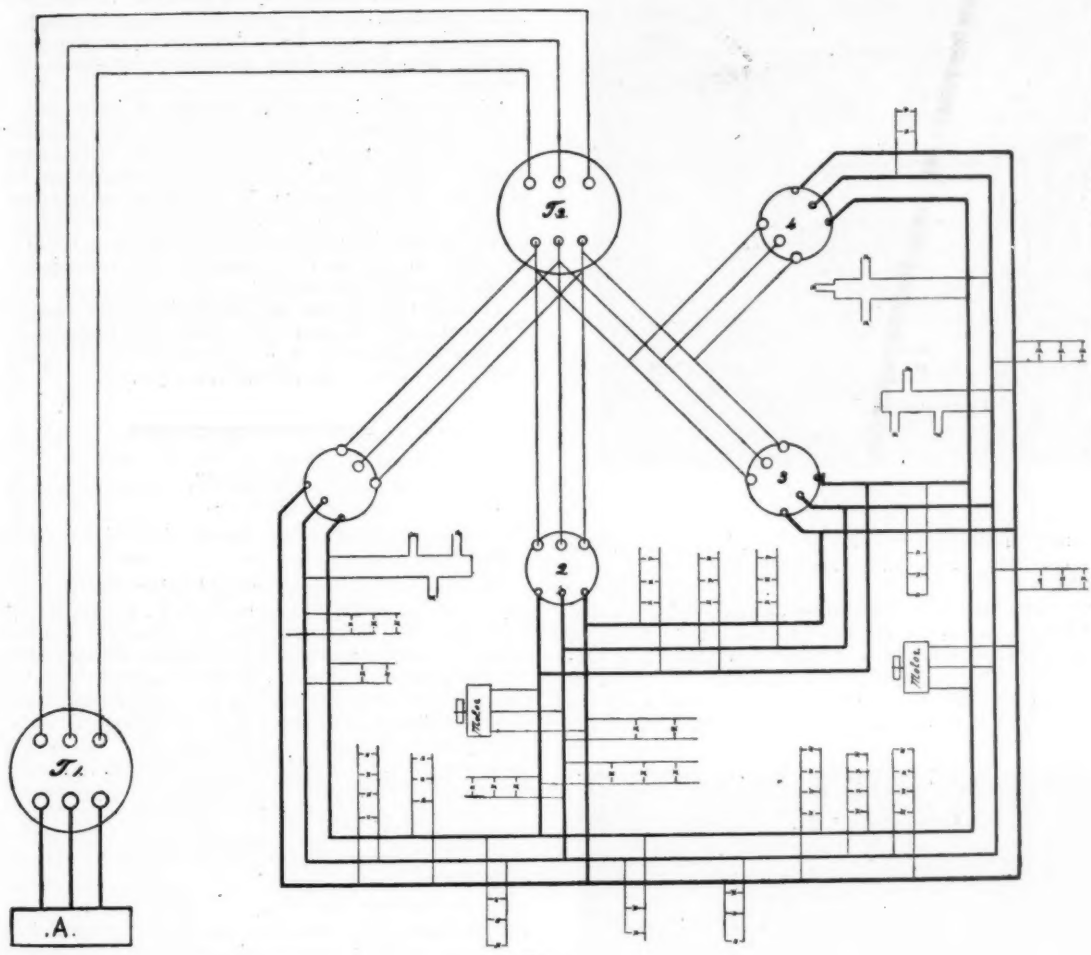


Fig. 1.

(To be continued.)

Electric Lighting at Bournemouth.—The Bournemouth Town Council have accepted an offer from Prof. Kennedy to advise that body with regard to the proposed system of electric lighting of the pier and gardens at a fee of fifty guineas, plus out of pocket expenses.

ELECTRIC TELPHERAGE INVENTED IN FRANCE BY RAYMOND IN 1866.

To Prof. Fleeming Jenkin is generally attributed the invention of the transport of little waggons by electricity, independently of any power exercised by the waggons themselves. This system has been designated by the name of "telpherage" by Prof. Fleeming Jenkin.

Nevertheless, on November 28th, 1866, a patent bearing the number 75,862 was granted to François-Prosper-Hippolyte Raymond for an electro-magnetic mode of transporting letters, despatches, &c., consisting essentially of suspended wires, serving as rails connecting with any source of electricity situated at the extremity of the line, and bearing a little electro-magnetic locomotive, drawing its power from the current passing through the rail-wires.

The following description, and the illustrations taken from Raymond's patent, will show that we should only give Prof. Jenkin the credit of having been the first to put into practice the system of telpherage, the fundamental principles of which had been laid down in Raymond's patent 15 years before Prof. Jenkin's first experiments:—

"The object of my invention is to utilise for the transport of letters, telegrams, &c., the electric current passing into the telegraph wires intended for the transmission of messages either along lines of railway, or from a station to a neighbouring village.

"The solution of this problem does away with the necessity for messengers, who often have to come from great distances to get the telegrams that have arrived at the principal station, and thus effects a considerable saving of time in the transmission of telegrams. The subjoined illustrations will explain my system.

"Figs. 1 & 2 show an end view and a side view of my despatch waggon.

"Fig. 3 shows the arrangement I employ for giving the telegraph wires the tension necessary for the good working of the transmitting apparatus.

"To put my invention into practice, I place on the telegraph posts along the railway a support A, bearing two arms on which rest the telegraph wires, *b*. In order that these

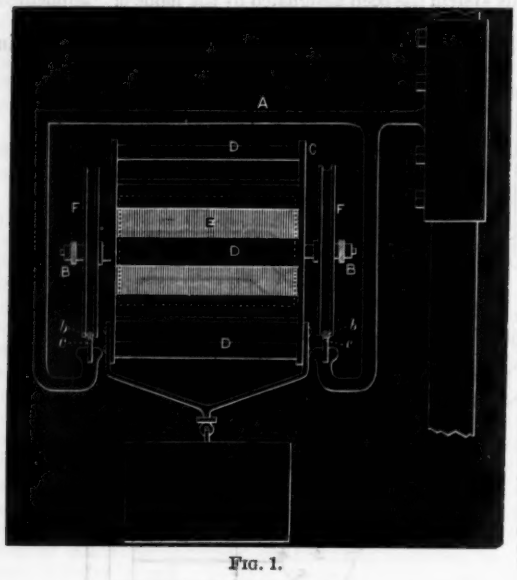


Fig. 1.

wires may be insulated from the supports, I fix them on to a plate, *c*, of ivory or any other material answering the same purpose.

"At certain intervals, every 200 or 300 metres, for instance, the wires which serve at the same time for the sending of messages and as rails for the telegram waggons are provided with stretchers as shown in fig. 3. These stretchers are placed alternately first on one wire and then on the other, in order that the tension may be equal. B is the

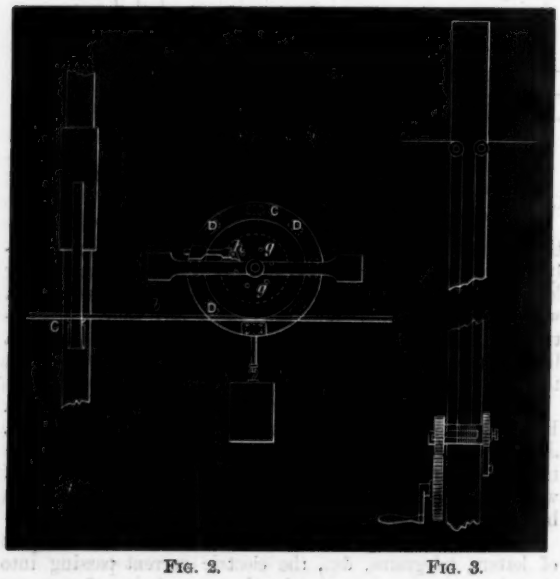


Fig. 2. Fig. 3.

waggon containing the telegrams. It consists of a framework to which is fixed the armature, C, formed of two copper discs connected by bars of soft iron, D. In the centre of these two discs is an electro-magnet, E, mounted on an axle terminated by the metal wheels, F. The extremities of the wires of the electro-magnet come against each of the wheels. On the outer rim of one of the wheels, F, is a series of projections, *g*, which are caught by the catch, *h*, on the fixed armature. Finally, this latter bears in addition two arms terminated by a hook, to which is suspended the box containing the letters or telegrams. This being arranged, when the current passes into the wire it is transmitted to the apparatus by the metal wheels, and by virtue of the arrangement of the electro-magnet and the fixed armature, a rapid rotation of the wheels is produced, the result of which is the propulsion of the waggon containing the letters along the telegraph lines. We must, however, impart an initial movement at first in order to start the waggon. It is evident that in order to send letters from stations to the principal villages, &c., the same system can be employed, either along telegraph wires already in use, or on lines constructed for the purpose. Having thus described my invention, my claims are as follows :—

"1. The realisation of the transport of letters and telegrams at express speed by using the electric current that serves for the sending of messages ; 2, the special arrangement of waggon which I employ for this purpose and which is shown in the drawing ; 3, the special arrangement of supports and stretchers which serve to keep the wires at the proper tension along the course of the waggon. I also claim the right to vary in form, material and dimensions, the different parts of the chariot."

The above description and illustrations show clearly that Raymond must be considered as the real inventor of the fundamental principles of the present system of telpherage. —A. M. Tanner.—(*L'Industrie Electrique.*)

REVIEWS.

Proceedings of the Physical Society of London. Vol. XI Part. III.

This number contains, amongst other matter, a short paper read before the Society by Prof. W. E. Ayrton and Mr. P. Mather, on "The Construction of Non-Inductive Resistances." The principal method of effecting the desired result consists in winding two bare platinoid wires of equal length and thickness into two spirals, one right-handed and the other left-handed, the diameters of the two spirals differing slightly from each other so that one spiral can be placed inside the other. They are then connected up in parallel, so that when a current is sent through them it circulates clockwise round one spiral and counter-clockwise round the other, the magnetic effects of the two thus tending to neutralise one another, and to produce a combination with small inductance.

Transactions of the American Institute of Electrical Engineers. Vol. VIII. New York : Published by the Institute, 12, West Thirty-first Street.

The chief contents of the volume are as follows :—

"Inductance and its Proposed Unit, the 'Henry,'" by A. E. Kennelly ; "The Improved Gramophone, by Emile Berliner ; "Report of the Committee on the Value of the 'Henry,'" "Report of High Speed Electric Railway Work," by O. T. Crosby ; "The Inventions of Thomas Davenport," by F. L. Pope ; "Inductive Disturbances on Telephone Circuits," by J. J. Carty ; "Electricity in the Production of Aluminium," by A. S. Brown ; "Some Possible Modifications in the Methods of Protecting Buildings from Lightning," by N. D. C. Hodges ; "The Perfection of Stationary Motors," by F. B. Crocker ; "A Photographic Study of the Electric Arc," by E. L. Nichols ; "A New Graphical Method of Calculating Leads for Wiring," by C. Hering ; "A Thermo-Electric Method of Studying Cylinder Condensation in Steam Engine Cylinders," by E. H. Hall ; "The Practical Aspects of Electric Welding," by F. A. C. Perrine ; "Experiments with Alternate Currents of Very High Frequency and their Application to Methods of Artificial Illumination," by Nikola Tesla ; "An Alternate Current Potentiometer," by C. S. Moler ; "Considerations which should govern the selection of a Rapid Transit System," by F. J. Sprague ; "Electric Meters," by G. W. Walker ; "A Study of an Open Coil Arc Dynamo," by M. E. Thompson ; "The Future of the Aluminium Problem from the Chemical Standpoint," by W. H. Wahl ; "Shall 'Aluminium' be 'Alium,'" by O. Smith ; "Notes

on Electricity in Mining Work," by S. F. Walker; "On the Relations of the Air Gap and the Shape of the Poles to the Performance of Dynamo-Electric Machinery," by H. J. Ryan; "Magnetic Reluctance," by A. E. Kennelly; "Report of Committee on Units and Standards," "Report of Delegation to the Frankfort Electrical Congress," by C. Hering; "Notes on the Frankfort Exhibition," by C. Hering; "On Polyphased Generators," by M. I. Pupin.

Formulaire de L'Electricien. By E. Hospitalier. 10th year. Paris: G. Masson, 120, Boulevard Saint Germain.

The present volume is a very full revision and recast of previous issues. The portions which relate to mechanics, physics, and mathematics have been placed at the commencement. The notations adopted throughout are those adopted (on the initiation of the author) at the Frankfort International Congress. In the second part, which deals with "Electrotechnics," several new tables with reference to conductors, resistances, insulation, &c., have been added. In the third part, apparatus and methods of measurement are fully dealt with. The fourth and last part, which contains the matter referring to the industrial applications of electric energy, is now very full and complete. Telegraphy and telephony are dismissed in a few pages, but the need for much matter on these subjects is but small. Altogether, the whole work continues to hold the very first position amongst books of the kind, and to still further add to the credit of the compiler.

Journal of the Institution of Electrical Engineers. Nos. 96 and 97. London: E. & F. N. Spon, 125, Strand.

The principal contents of these Nos. are as follows:—No. 96, "Electrotechnics," by Prof. W. E. Ayrton; No. 97, "Some Experimental Investigations of Alternate Currents," by Alexander Siemens; "On the Specification of Insulated Conductors for Electric Lighting and other Purposes," by W. H. Preece.

L'Année Electrique ou Exposé Annuel des Travaux Scientifiques des Inventions. By Ph. Delahaye. 8th year. Paris: Baudry et Cie., Rue des Saintes-Pères.

The present issue of this work contains chapters on "The Electric Light," "Batteries and Accumulators," "Telegraphy," "Telephony," "Atmospheric Electricity," "Medical Electricity," "Electrolysis and Electro-Metallurgy," "Applications to Railway Working," "Electrical Transmission of Power," "Measurements and Experiments," "Miscellaneous Apparatus," "Obituary." In the first chapter references are made to Tesla's alternator, the Oerlikon apparatus, Swinburne's transformer, various arc lamps, &c. In the second chapter, a dozen batteries and about the same number of accumulators are briefly described; there are also several pages devoted to the use of accumulators in central stations. In telegraphy, the Munier multiple printer forms the chief consideration. In "Telephony," a selection of various improvements and changes which have been made in switchboards is, perhaps, of most interest. "Atmospheric Electricity" (always a favourite subject on the Continent) is dealt with in some 30 pages. Useful statistics are given with reference to "The Applications of Electricity to Railway Working," the London Electric Railway being included under this heading. In the "Obituary," the names of Becquerel, Boudet, Brooks, Caselli, Crossley, Massmann, Nystrom, Oussow, Raikes, Reynier, Willoughby Smith, and W. Weber, are included.

The Year-Book of Science. Edited for 1891 by Prof. T. G. Bonney, F.R.S. London: Cassell & Company, Limited.

To deal with such a huge mass of material as exists, showing the progress which science makes from year to year, is no easy task, and if the editor of the Year-Book of Science has failed to thoroughly deal with the general subject, it is only because the task would be an impossible one. We think, however, that Prof. Bonney and his associate editors have shown great discrimination in their work, and have gathered together a collection of facts of much interest. Briefly, the several headings are "Physics," "Chemistry," "Geology and Mineralogy," and "Biology." The first section, under which "Electricity and Magnetism" are included, has been dealt with by Messrs. H. H. Hoffert, D.Sc. and P. L. Gray, B.Sc., the researches of Nikola Tesla coming in for a fair share of attention. That a large amount of ground has been gone over is instanced by the fact that the names in the "Index to names of Author's quoted," approaches 1,000 in number. A very complete index adds greatly to the value of the volume.

A Guide to Electric Lighting for the Use of Householders and Amateurs. By S. R. Bottone. London: Whittaker and Co., Paternoster Square.

No one could reasonably complain of this book on the score of price (1s.), as it is certainly a cheap 200 pages. The aim has been to "afford, in a succinct and concise manner, an insight into the general principles which govern the production of light by electricity; and into the appliances indispensable to attain that result." The commencement of the book is unfortunate, as what possible use it can be to devote some 30 pages to full descriptions of primary batteries, not one of which are ever heard of in connection with the electric light as it is produced in practice, it is difficult to see. With Chapter II. really commences the practical portion of the book, and here the principle of the dynamo is as meagrely treated as the action of batteries has been fully so; this, to some extent, however, is made up for by fairly distinct diagrams illustrative of different methods of dynamo winding. A number of illustrations show various types of dynamos, though to the uninitated public these cannot afford much information as to their construction. The latter part of the chapter, which deals with the arrangement of lamps, is much to the point, and is well and clearly written. In Chapter III. we have arc lamps dealt with, the general principle of these lamps being explained by the Archerau elementary type. The illustration of the action of the Brush lamp is not a particularly happy one, and it is doubtful if any amateur could understand it; clearness of illustration is of essential importance in works intended to be of a popular character.

The chapter on accumulators is perhaps one of the best in the book; in fact, is decidedly good. The illustrations of the Walsall and Cardew voltmeters are wholly undescribed, and afford no information whatever to the reader. Transformers are very briefly dealt with; in fact, as regards information afforded, the chapter might almost as well have been omitted. Chapter VIII., in which cost of lighting is considered, contains matter of real use to the public, though too much is made of the value of batteries for the purpose. Taking the book altogether, we cannot compliment the author particularly upon its being a praiseworthy production, but a shilling might be worse spent than upon a copy of the work, as useful facts can undoubtedly be gleaned from the same.

NEW PATENTS—1892.

6,888. "An improved conduit system for electric conductors." W. L. Spence. Dated April 11th.

6,911. "Improvements in change-over mechanism for electric arc lamps." W. J. Davy. Dated April 11th.

6,949. "Improvements in and apparatus for the electrolysis of solutions of salts or compounds of the alkalies, more especially intended for the manufacture or production of alkalies and chlorine, and for bleaching." J. Marx. Dated April 11th.

6,954. "Improved means of producing motive power and electricity." R. J. Crowley and W. Walker. Dated April 11th.

6,961. "Improvements in automatic switches for electrical apparatus." A. Heil. Dated April 11th. (*Complete.*)

6,989. "Improvements relating to conduits, applicable for combined use as casings for electrical conductors and for gas supply, or for either use separately." J. A. McMullen. Dated April 12th.

7,003. "Improvements in coal cutting machines with special reference to electrical motive power." R. J. Charleton and H. Walker. Dated April 12th.

7,004. "Improvements in electrical cooking apparatus." A. Wallace. Dated April 12th.

7,008. "Improvements in electric light fittings." W. A. Heyes. Dated April 12th.

7,009. "An improved telephone transmitter." H. Skipper and H. J. Pierce. Dated April 12th.

7,016. "Improvements in electric fittings." J. McFarlane and W. B. Edgar. Dated April 12th.

7,029. "Improvements in electric cables." G. G. M. HARDINGHAM. (Communicated by the firm of Felten and Guilleaume, Germany.) Dated April 12th.

7,037. "An improvement in electric arc lamps." R. BELFIELD. Dated April 12th.

7,044. "Improvements in dynamometers." E. J. WOOD. Dated April 12th. *(Complete.)*

7,081. "Improvements in telephone and electric signalling circuits between trains and signal boxes." J. D. HICKMAN. Dated April 12th.

7,095. "Improvements in electric arc lamps." J. SUGDEN and W. J. L. SANDY. Dated April 13th.

7,126. "Improvements in electrical distribution." A. WRIGHT. Dated April 13th.

7,142. "An improved method of renewing incandescent electric lamps." E. A. KRUGER. Dated April 13th.

7,144. "Improvements in secondary batteries." G. H. CUTTING. Dated April 13th.

7,170. "An improvement in primary batteries." T. E. WEATHERALL. Dated April 14th.

7,172. "Electrical surgical instruments." S. R. BRADLEY. Dated April 14th. *(Complete.)*

7,173. "An improvement in electric signals." A. WHALLEY. Dated April 14th.

7,206. "Improvements in or connected with connections or couplings for electric and other cables and ropes." A. A. VOYSEY. Dated April 14th.

7,220. "An improved primary battery." F. B. STONE. Dated April 14th.

7,226. "Improvements in or relating to the electric treatment of metal or other bodies." C. H. A. HOHO and E. A. C. LAGRANGE. Dated April 14th.

7,235. "Improvements in coal-cutting machines with special reference to the application of electrical motive power." R. J. CHARLETON and H. WALKER. Dated April 14th.

7,237. "Improvements in commutators for electrical machines." B. S. PATERSON and J. B. FURNEAUX. Dated April 14th.

7,252. "Improvements in electrical distributing apparatus." R. E. B. CROMPTON and W. A. CHAMEN. Dated April 14th.

7,253. "Improvements in generating electricity and producing air in a luminous state, and in apparatus therefor." T. DUFFY. Dated April 14th. *(Complete.)*

7,264. "Improvements in electric arc lamps." H. T. HARRISON. Dated April 14th.

7,275. "Improvements in electric meters." H. W. MILLER. Dated April 16th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1890.

The Price of all Specifications (old and new) is now 8d. each.

20,992. "Improvements relating to electric bells." G. H. JONES. Dated December 23rd. Consists in the combination with an ordinary door knocker of any suitable description of a push piece or other device for completing the electric circuit to an electric call or other bell, so that when the said knocker is used the said electric call or other bell will be also rung or operated. Comprises moreover means for ensuring the ringing or sounding of an electric call or other bell for a given or predetermined length of time at each operation thereof, whether the said operation be produced by means of the said knocker or otherwise. 9 claims.

1891.

2,642. "Improvements in telephone receiving instruments." E. J. P. MERCADIER. Dated February 13th. Claims:—1. In a telephone receiving instrument, a nipple-like protuberance (covered or not with caoutchouc) to enter the ear, and serving not only to support the instrument, but also to bring the sounds received as near as possible to the tympanum. 2. The combination, with nipple-like protuberances, as referred to in Claim 1, of a V-shaped spring, connecting two receiving instruments. 3. The employment of the said V-spring to establish electrical communication between the two instruments, and to increase or maintain their magnetisation. 4. The improved telephone receiving instrument or bitelephone, described and represented in the drawing.

5,638. "Improvements in electric batteries." W. A. CROWDUS. (Under International Convention.) Dated October 7th, 1890. Consists in constructing the carbon negative plate of the battery to constitute a portion of the porous partition or diaphragm separating the two solutions. The remainder of the porous diaphragm consists of a plate of unglazed earthenware, such as is commonly used in batteries, but this plate is made very much thinner than heretofore, thereby reducing its electrical resistance. The carbon plate is placed against and held to the earthenware plate, so that it contributes in co-operation therewith to maintain the separation of the two liquids. 7 claims.

6,072. "Improvements in electro-heating apparatus." C. E. CARPENTER. (Under International Convention.) Dated September 27th, 1890. The prime object of this invention is to have the resistance permanently attached to but insulated from the plate to be heated, by an adhesive material, which will also withstand the heat to which it will be subjected in use, without deterioration. 2 claims.

6,276. "Electric locking devices for the gear wheels of motors of electric cars (or carriages)." G. W. BLANCHARD. Dated April 13th. The chief objects of this invention are to provide a positive gear-locking device for electric cars, which will become operative to stop the car if the latter, on failure of the current, begins to run backward down hill; and to arrange for controlling the braking devices, and also the impelling motor of the car by a single circuit closer and indicator, which may be located on the platform, and easily manipulated. 4 claims.

6,292. "An improved form of insulator for use with electrical currents." H. W. MILLER. Dated April 13th. Claim:—an improved form of insulator for use in a system of underground mains for the distribution of electrical energy, and having an internal insulating surface equal to or greater than the external insulating surface, substantially as described.

6,831. "Improvements in dynamo-electric machines." A. L. PARCELLE. Dated April 21st. Consists in mounting a series of multiple radial field-magnets in the same vertical plane in suitable supports, and surrounding them by a concentric continuous Gramme-ring armature, supported by, and enclosed in a suitable frame or casing mounted on a rotating shaft. 4 claims.

6,846. "Improvements in printing telegraphs." S. R. LINVILLE. Dated April 21st. Consists, first, of the electric circuits for controlling the alternating and unison devices located at a central station, when the same are controlled by means of the printing line. Consists, secondly, in connecting any two subscriber instruments in parallel circuit through their type-wheel lines, in which alternating currents of like polarity simultaneously circulate. Consists, thirdly, in the method employed for controlling the neutral relays operating the printing circuits at two connected instruments by means of a resistance and devices at a transmitter for cutting out the resistance in one branch of the parallel circuit, thereby increasing at will the current to the transmitter, and at the same instant diminishing the current to the receiver. Consists, fourthly, in the method employed for sending a signal from a subscriber station, and recording the same by means of registering apparatus and an annunciator at a central station. 66 claims.

7,160. "An improved method of producing a hermetical seal for the connecting wires of the filaments of incandescent lamps." F. WALTER. Dated April 25th. In order to receive the wires connected to the carbon filament, and for producing the airtight seal, the globe is provided with two hollow projections, which either alone, or in combination with metallic shells or capsules, are charged with a molten alloy. The capsules are charged with fluid metal alloy, the coefficient of expansion of which corresponds with that of the glass, or the same are filled with an appropriate cement, so that a comparatively large sealing surface is produced, which will effectually resist the influences of temperatures. 2 claims.

7,204. "Improvements in electric alarms." W. KINGSLAND. Dated April 27th. Consists of an electro-magnet, which is included in the main circuit, and which has an armature hinged or pivoted at one end, and placed in such a position that it will fall by its own weight unless prevented from doing so by the attraction of the magnet. The falling weight of the armature is made use of to liberate a catch or other device, whereby the alarm is given on a mechanical alarum, or whereby a local electric bell circuit is closed. 4 claims.

7,353. "Improvements in electric railway systems." J. P. BAYLY. (A communication from abroad by D. G. Weems, of America.) Dated April 29th. The object of the invention is to improve the several systems heretofore patented by the inventor, with a view to reducing to a minimum the frictional resistance of the air, and to so locate and lubricate the moving parts that greatly increased speed is obtained without a material increase in the force of the electric current. 16 claims.

7,715. "Improvement in storage batteries." G. A. WASHBURN. Dated May 5th. Consists in an outside containing vessel of hard rubber, glass, or other suitable material, a cup of lead, or other conducting material within the receptacle, and an inner perforated conducting plate or tube set a suitable distance from the cup, so that active material may be placed between said cup and plate. 8 claims.

7,755. "Improvements in and relating to electric motors or dynamo-electric machines." H. H. LAKE. (Communicated from abroad by the Crocker Wheeler Electric Motor Company, of New York.) Dated May 5th. Consists in certain improvements especially applicable to a toothed form of the Gramme ring, the object being to increase, as much as possible, the amount of conductor or winding, and to present as large a tooth surface as possible to the field: to have the openings of the slots so narrow compared with the iron portions or teeth lying between them, that the pole pieces can be brought close to the armature core without the production of eddy or Foucault currents in the pole pieces, and to provide a better means of mechanically mounting the armature upon its shaft. 11 claims.

7,762. "Improvements in reciprocating electric engines." C. J. VAN DEPOELE. Dated May 5th. Comprises an improved method of operating a reciprocating drilling engine, together with a novel arrangement of circuits and connections whereby the combined effects of a plurality of motor coils are imparted to a magnetic piston adapted to be reciprocated therethrough. 7 claims.

7,970. "Improvements in distributing electric energy." E. A. WAHLSTROM. Dated May 8th. The idea is to send two different alternating currents coming from the generator in displaced phases into a common conductor, which conveys both currents, and to employ the current passing this central conductor in combination with the two alternating currents to produce a rotary magnetic field. 1 claim.

CRYSTAL PALACE ELECTRICAL EXHIBITION, 1892.

Siemens's Railway Signalling Apparatus.

(*Concluded from page* 526.)

Fig. 6 represents a portable recording instrument for transport in the guard's van, complete, with a transmitting key, paper wheel, and safety ink trough, all enclosed in a folding wooden protecting case with leather straps.

In case the station apparatus for receiving the "signals for help" consists of a trembling bell only (see fig. 7), then the closed circuit current from the battery at terminal station A passes through the bobbins of that bell,

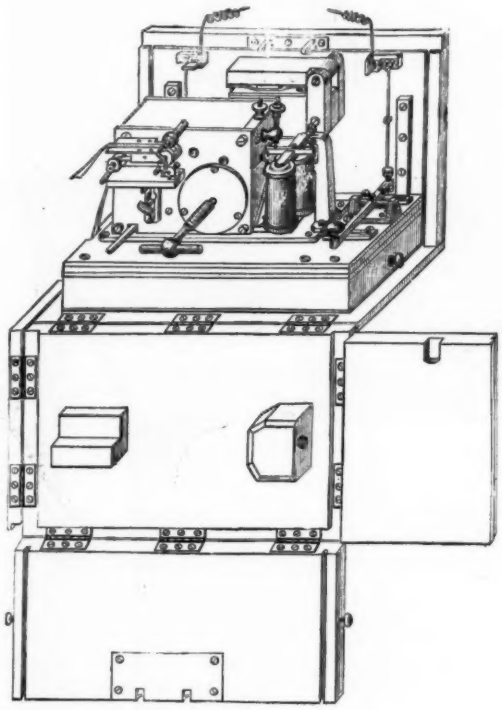


Fig. 6.

through all the electro-magnets of the pillars in circuit, then through the bobbins of the trembling bell and the battery at station B to earth, and back to station battery A, thus completing the circuit.

As soon as the closed circuit current is interrupted by either the rotation of a code disc or the working of the Morse key at any of the pillars, the armatures of the station bells are no more attracted, but are drawn away from the poles of their electro-magnets by their antagonistic springs. A local circuit is hereby momentarily established at each station the current now passing from the battery through the bobbins of the trembling bell, thence through the body of the instrument and back to the battery. The closed circuit battery thus becomes a local battery during the interruptions of the line circuit, the bells begin trembling, whereby the signal sent from any particular gong pillar is audibly reproduced at both stations.

In arranging a gong circuit between two stations the opposite poles of the closed circuit batteries of both stations must be connected with the terminals of the station bells, so as to add and not to oppose the currents from the two batteries. Thus, for instance, the zinc of the battery at the one station is connected to earth, whereas at the other station the copper is led to earth. If there are a number of stations connected in series, and the first has zinc to earth, then both batteries of the second station must have copper to earth, and so on. The electro-magnets of all the pillars are so adjusted that these weak closed circuit battery currents cannot attract their armatures, and therefore cannot set the gongs ringing. But these voltaic currents have power enough to attract the armatures of the small station bells, thus producing audible signals at both stations, in accordance with the Morse signals cut out upon the periphery of the rotating disc. Hence, as soon as any of the contact-breaking discs is set rotating at any of the pillars, the closed circuit current is interrupted, and a local circuit is momentarily established at each station bell, whereby the signal for help sent from any particular pillar is received by these chattering bells of the up and down station.

When sending a magneto-inductor current through the same wire for the purpose of ringing the gongs, this current passes through the bell apparatus and the battery at the advanced station before going to earth, and if this inductor current and the closed circuit battery current were of different polarity, so as to act against each other, the effect of the inductor currents upon the electro-magnets of the pillars would be lessened. The inductors must, therefore, as mentioned before, be connected up with the voltaic batteries in such a way that if earth is in connection with the zinc poles of the batteries at the first station, then earth must be connected to the copper poles at the second, and again to the zinc poles at the third station, and to the copper poles at the fourth, and so on.

In many cases, however, it is not considered sufficient to receive the signals for help by means of trembling bells only, it being preferred to have them recorded. In such cases the improved railway telegraph recording instruments (see fig. 8), are used in place of the simple trembling bells; these instruments consist of a Siemens normal inker, with relay, galvanoscope, key, lightning discharger and commutator, mounted on a general base board, which fits into a specially constructed table. The top of this table is recessed and provided with spring contacts, which match similar contacts on the base board of the instrument. The tables and instrument boards are all made exactly alike, and any of the latter fit into the recess of any of the station tables, so that, in case of an instrument getting out of order, and its board be removed from the table, the spring contacts of the latter immediately close automatically, thus maintaining the continuity of the line circuit, and only excluding the defective instrument.

In adopting recording instruments, instead of trembling bells for receiving signals for help, it becomes possible to receive also ordinary telegraphic correspondence over the same line wire, when the same ink-recording instrument is used for receiving the automatic signals for help and the telegraphic correspondence.

Recording instruments for railway service are preferably worked in local relay circuit, but sometimes direct working inkers are employed for the same purpose.

When any of the contact-breaking discs at any of the pillars is set in rotation for the purpose of sending an automatic signal from that pillar to the stations, or when the current is interrupted at either of the two stations or at any of the gong pillars by means of the transmitting key, the closed circuit is broken, and the trembling bells at both stations ring. The "up" or "down" switch, as the case may be, must then be turned to the left, and the automatic signals or telegraphic correspondence can at once be received by the relay and local inker. The station-bell has then ceased to act as a trembling bell, because the line current passes now to the switch-terminal, thence to one of the plates of the lightning discharger, through the electro-magnet of the relay, back-contact of transmitting-key, galvanoscope, second plate of lightning discharger, auxiliary line-battery (which adds its current to that of the line-battery, and thence to earth. The tongue of the relay is then moved on to the working contact, thus closing the circuit of the local battery which works the inker. Supposing the local inker is switched into the circuit by turning the left-hand switch to the left, then the local current passes through the

electro-magnets of the inker to the working contact of relay, over the relay tongue to the switch-terminals and back to the local battery, thus completing the local circuit.

After the automatic signals, or the correspondence between two neighbouring stations, or between a pillar and a station, have been received, the hand-switch must again be turned to its normal position, viz., to the right, so that the trembling bell is again ready to receive any further call.

In order to prevent an attendant forgetting to turn the hand-switch back to its normal position, these apparatus tables are often provided with the pedal-switches instead of the two hand-switches. By depressing any of the pedals the relay is switched into the line-circuit, and when the foot is removed, the switch automatically returns to its former normal position, thus putting the bell again in circuit ready to receive another call.

In the foregoing description it has been assumed that the gong-signals are sent by the magneto-inductor from the home station to that next in advance, at the time a train is ready to leave or passes the home station, that is to say, the signals are sent in the same direction in which the train runs. This arrangement is most generally adopted on double-track-lines, but for lines with only a single track for the "up" and the "down" traffic, it is usual to send the gong-signals from the advanced station to the home station, that is to say, in a direction opposite to the run of the train. In these cases the home station must first ask permission to start the train, and this permission is given by ringing the gongs from the advanced towards the home station.

To prevent two trains travelling in opposite directions on the same section of line, a forced co-operation between the two stations and between each station and its out-door semaphores is frequently adopted. If, for instance, a train travels from station A towards station B, the home station A is compelled to ask the advanced station B whether the train may proceed, being unable to give the outdoor line clear signal, before such permission has been received from the advanced station, which first must ring the gongs.

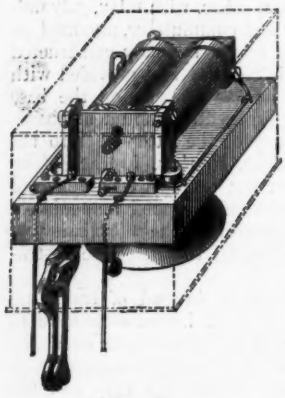


Fig. 7.

To carry out this enforced dependence, the magneto-inductor at each station is thus interlocked with its own home semaphore, so that the gong signal from the advanced station which gives the permission for the train to start, can only be given after its own out-door semaphore has been set to "danger;" thus preventing the departure of a train from that station in the direction opposite to that of the signalled train.

The out-door semaphore at station B is in a similar manner kept at "danger" until from the next station in advance, C, permission has been requested and obtained for the train now at station B to proceed towards C. The same inductor current, which then locks the out-door "danger" semaphore in C, and rings the gongs along the section of line between C and B, equivalent to a permission for the train to start from B towards C, also unlocks B.'s semaphore, which can only then be lowered to "clear," proper sidings being provided, where trains travelling in the opposite direction can be kept waiting, until the section of line is free.

A railway telegraph line may be used for two distinct purposes, viz. :—

1. For transmitting signals which regulate the traffic of trains.

2. For transmitting service or ordinary messages.

The adoption of one line wire only for both purposes suffices for railways with but a limited use for the telegraph, and such arrangement should only be permitted on lines with few trains running. On busy lines it is requisite to separate the telegraph work from the signalling service, in order to avoid delays in the latter, which is of greater importance. A special line wire with its own receiving apparatus should therefore be adopted for the gong and automatic signals for help, and in addition a second line wire and ink recorder should be exclusively used for other telegraphic communications.

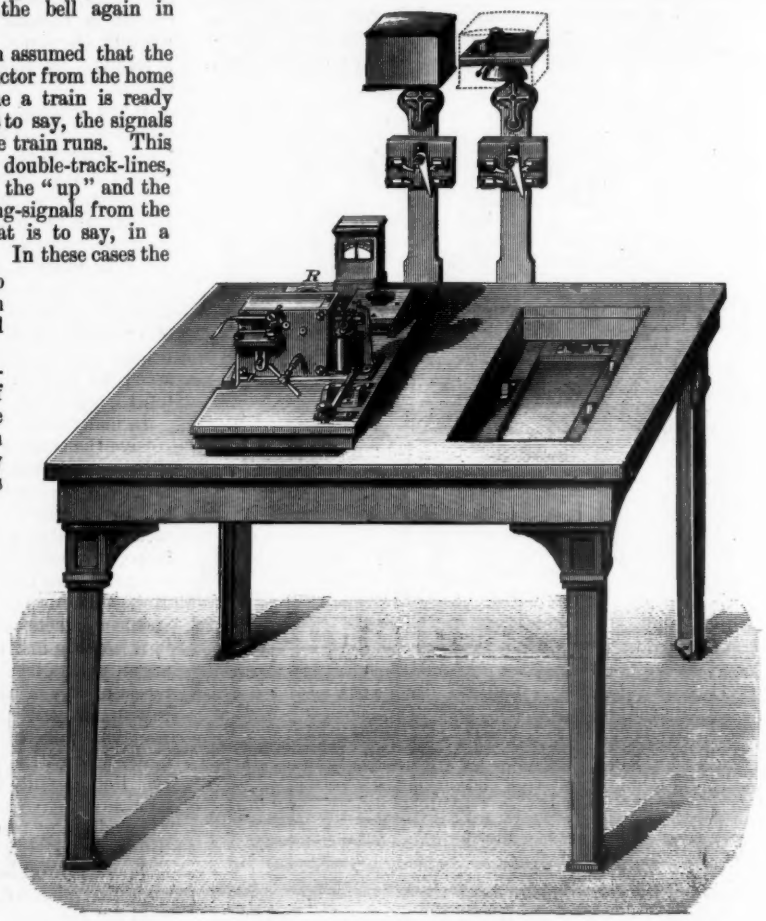


Fig. 8.

In some countries, for instance, in Germany, Austria, Denmark, &c., the Government considered the adoption of gong signalling as absolutely necessary for the safety of the railway traffic, and made these apparatus compulsory upon all lines, while in other countries, France, Spain, &c., certain classes of line only are compelled to use gongs. The generally recognised advantages of, and the greater security resulting from gong signalling have already induced a very considerable number of railway companies to adopt this apparatus, so that the aggregate number of Siemens's gong pillars in actual use amounts to more than 30,000, distributed over 130 railways in Germany, Austria, Russia, France, Holland, Belgium, Denmark, Italy, Switzerland, Norway, Sweden, Brazil, Chili, Argentine Republic, Uruguay, &c., and the demand for which is steadily increasing.

These gongs are also extensively adopted as fire alarum apparatus in towns, and also in arsenals, factories, wharfs, farming establishments, plantations, &c.